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San Juan Basin Action Plan

SOILS,
PRIME AND UNIQUE FARMLANDS
TECHNICAL REPORT

for the
Environmental Impact Statement
on Public Service Company of New Mexico's
Proposed New Mexico Generating Station
and Possible New Town

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NM30840EIS
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October 1982

Dear Interested Citizen:

Attached is one of twenty-two technical reports developed as a basis for writing the Environmental Impact Statement on Public Service Company of New Mexico's Proposed New Mexico Generating Station and Possible New Town (NMGS EIS). (A list of the technical reports is attached.)

These technical reports provide detailed information on the existing environment, methods used for the impact analysis, and related data supportive of the analysis and conclusions presented in the EIS. These reports should be retained for use with the Draft and Final EIS and other documents related to BLM's San Juan Basin Action Plan (SJBAP).

The Draft NMGS EIS will be filed with the Environmental Protection Agency and released for public review on November 30, 1982. Comments on the Draft EIS will be due by close of business February 7, 1983, at the BLM New Mexico State Office. Because of the large volume of material presented in the technical reports, the BLM is distributing these reports in advance of the Draft EIS to provide sufficient time for public review. The technical reports will be available for public review at the places indicated on the attached list. Copies will also be available from the BLM New Mexico State Office, U.S. Post Office and Federal Building, Santa Fe, for a copy fee.

Informational public meetings are scheduled for December 1982 to provide a public forum to clarify questions and concerns about the SJBAP proposals and the related environmental documents, which will all have been issued by that time. The meetings are scheduled as follows:

- December 14, Civic Center, Farmington, 3 to 9 PM
- December 14, Convention Center, Albuquerque, 3 to 9 PM
- December 15, Chapter House, Crownpoint, 3 to 9 PM
- December 16, Holiday Inn, Gallup, 3 to 9 PM
- December 16, Kachina Lodge, Taos, 3 to 9 PM

In addition, formal public hearings will be held in January 1983 to solicit public comments on the SJBAP Proposals. These meetings are scheduled as follows:

- January 10, Chapter House, Crownpoint, beginning at 1:00 PM
- January 12, Civic Center, Farmington, beginning at 9:00 AM
- January 14 (and 15th if necessary because of the number of registrants), Four Seasons Motor Lodge, Albuquerque, I-40 and Carlisle Blvd., beginning at 9:00 AM (each day)

Questions on the public meetings, hearings, and the technical reports themselves should be directed to:

Leslie M. Cone
NMGS Project Manager
BLM, New Mexico State Office
P.O. Box 1449
Santa Fe, NM 87501
(505) 988-6184 FTS 476-6184

Sincerely yours,

Charles W. Luscher

Charles W. Luscher
State Director, New Mexico

List of Technical Reports

1. Purpose and Need
2. Project Description
3. Alternatives to the Project
4. Site Alternatives
5. Permit Reconnaissance
6. Air Quality
7. Geologic Setting
8. Mineral Resources
9. Paleontology
10. Soils, Prime and Unique Farmlands
11. Hydrology
12. Water Quality
13. Vegetation
14. Wildlife and Aquatic Biology
15. Threatened and Endangered Species
16. Cultural Resources
17. Visual Resources
18. Recreation Resources
19. Wilderness Values
20. Transportation
21. Social and Economic Conditions
22. Land Use Controls and Constraints

Availability of Technical Reports for Public Review

Individual copies of the technical reports can be obtained for a copy fee. Inquiries should be directed to:

Bureau of Land Management, New Mexico State Office
Title Records and Public Assistance Section (943B)
U.S. Post Office and Federal Building
P.O. Box 1449
Santa Fe, NM 87501
(505) 988-6107 FTS 476-6107

Copies of the reports are available for public review at the locations listed below. [Formal and informal cooperating agencies are denoted by an asterisk (*).]

BUREAU OF LAND MANAGEMENT OFFICES

New Mexico State Office

NMGS Project Staff (934A)
Room 122, Federal Building
Cathedral Place
P.O. Box 1449
Santa Fe, NM 87501
(505) 988-6184 FTS 476-6184

San Juan Energy Projects Staff (911)
Room 129, Federal Building
Cathedral Place
P.O. Box 1449
Santa Fe, NM 87501
(505) 988-6226 FTS 476-6226

Public Affairs Staff (912)
Room 2016
U.S. Post Office and Federal Building
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Santa Fe, NM 87501
(505) 988-6316 FTS 476-6316

Division of Resources(930)
509 Camino de los Marquez, Suite 3
P.O. Box 1449
Santa Fe, NM 87501
(505) 988-6212 FTS 476-6212

Albuquerque District Office
3550 Pan American Freeway NE
P.O. Box 6770
Albuquerque, NM 87107
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Farmington Resource Area Headquarters
900 La Plata Road
P.O. Box 568
Farmington, NM 87401
(505) 325-3581

Taos Resource Area Office
Montevideo Plaza
P.O. Box 1045
Taos, NM 87571
(505) 758-8851

Socorro District Office
198 Neel Avenue
P.O. Box 1219
Socorro, NM 87801
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Carlsbad, NM 88220
(505) 887-6544

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Santa Fe, NM 87503
(505) 827-5217, ext. 2416

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525 Camino de los Marquez
P.O. Box 2770
Santa Fe, NM 87503
(505) 827-3326

New Mexico Historic Preservation Bureau*
State Historic Preservation Officer
505 Don Gasper Avenue
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Villagra Building
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Bataan Memorial Building
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(505) 827-3361

New Mexico State Engineer's Office*
Bataan Memorial Building
Santa Fe, NM 87503
(505) 827-2423

New Mexico State Planning Office*
505 Don Gasper Avenue
Santa Fe, NM 87503
(505) 827-5191

OTHER ORGANIZATIONS

Public Service Company of New Mexico
Alvarado Square
P.O. Box 2268
Albuquerque, NM 87158
(505) 848-2700

Woodward-Clyde Consultants, Inc.
3 Embarcadero Center, Suite 700
San Francisco, California 94111
(415) 956-7070

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Reading copies of the NMGS EIS and associated technical reports will be available at the following public and university libraries:

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Albuquerque, NM 87102

Aztec Public Library
201 W. Chaco
Aztec, NM 87401

Crownpoint Community Library
c/o Lioness Club, P.O. Box 731
Crownpoint, NM 87313

Cuba Public Library
Box 5, La Jara
Cuba, NM 87027

Farmington Public Library
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Farmington, NM 87401

Gallup Public Library
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Santa Fe, NM 87503

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Bureau of Indian Affairs*
Eastern Navajo Agency
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Crownpoint, NM 87313
(505) 786-5228

Bureau of Indian Affairs*
Navajo Area Office
Box M - Mail Code 305
Window Rock, AZ 86515
(602) 871-5151 FTS 479-5314

Bureau of Reclamation*
Upper Colorado Regional Office
125 S. State Street
P.O. Box 11568
Salt Lake City, UT 84147
(801) 524-5463 FTS 588-5463

Minerals Management Service*
South Central Region
505 Marquette Avenue NW, Suite 815
Albuquerque, NM 87102
(505) 766-1173 FTS 474-1173

Minerals Management Service*
Resource Evaluation Office
411 N. Auburn
Farmington, NM 87401
(505) 327-7397 FTS 572-6254

National Park Service*
Southwest Regional Office
1100 Old Santa Fe Trail
Santa Fe, NM 87501
(505) 988-6375 FTS 476-6375

National Park Service*
Environmental Coordination Office
Pinon Building, 1220 St. Francis Drive
P.O. Box 728
Santa Fe, NM 87501
(505) 988-6681 FTS 476-6681

U.S. Fish and Wildlife Service*
Field Supervisor, Ecological Services
3530 Pan American Highway, Suite C
Albuquerque, NM 87107
(505) 766-3966 FTS 479-3966

U.S. Geological Survey (WRD)*
505 Marquette Avenue, Room 720
Albuquerque, NM 87101
(505) 766-2810 FTS 474-2817

OTHER FEDERAL AGENCIES AND ORGANIZATIONS

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Region VI
1201 Elm Street
Dallas, TX 75270
(214) 767-2716 FTS 729-2716

Navajo Tribe*
c/o Division of Resources
P.O. Box 308
Window Rock, AZ 86515
(602) 871-6592

Pueblo of Zia*
General Delivery
San Ysidro, NM 87053
(505) 867-3304

Soil Conservation Service*
424 N. Mesa Verde
Aztec, NM 87410
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Albuquerque, NM 87103
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USDA, Forest Service*
717 Gold Avenue
Albuquerque, NM 87102
(505) 474-1676 FTS 474-1676

USDA, Forest Service*
District Ranger
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Farmington, NM 87401

University of New Mexico, Gallup Campus
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SOILS, PRIME AND UNIQUE FARMLANDS TECHNICAL REPORT

for the

Environmental Impact Statement on Public Service Company of New Mexico's Proposed New Mexico Generating Station and Possible New Town

Prepared by

Woodward-Clyde Consultants

for the

U.S. Department of the Interior
Bureau of Land Management

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POSSIBLE NEW TOWN

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NEW MEXICO GENERATING STATION

1.0
INTRODUCTION

BACKGROUND

Included in the recent Council on Environmental Quality Regulations (1979) are several important objectives to reduce excessive paperwork in the preparation of environmental impact statements (EISs):

- Discuss only briefly issues other than significant ones.
- Emphasize the portions of the EIS that are useful to decision makers and the public and reduce emphasis on background material.
- Prepare analytic rather than encyclopedic EISs.

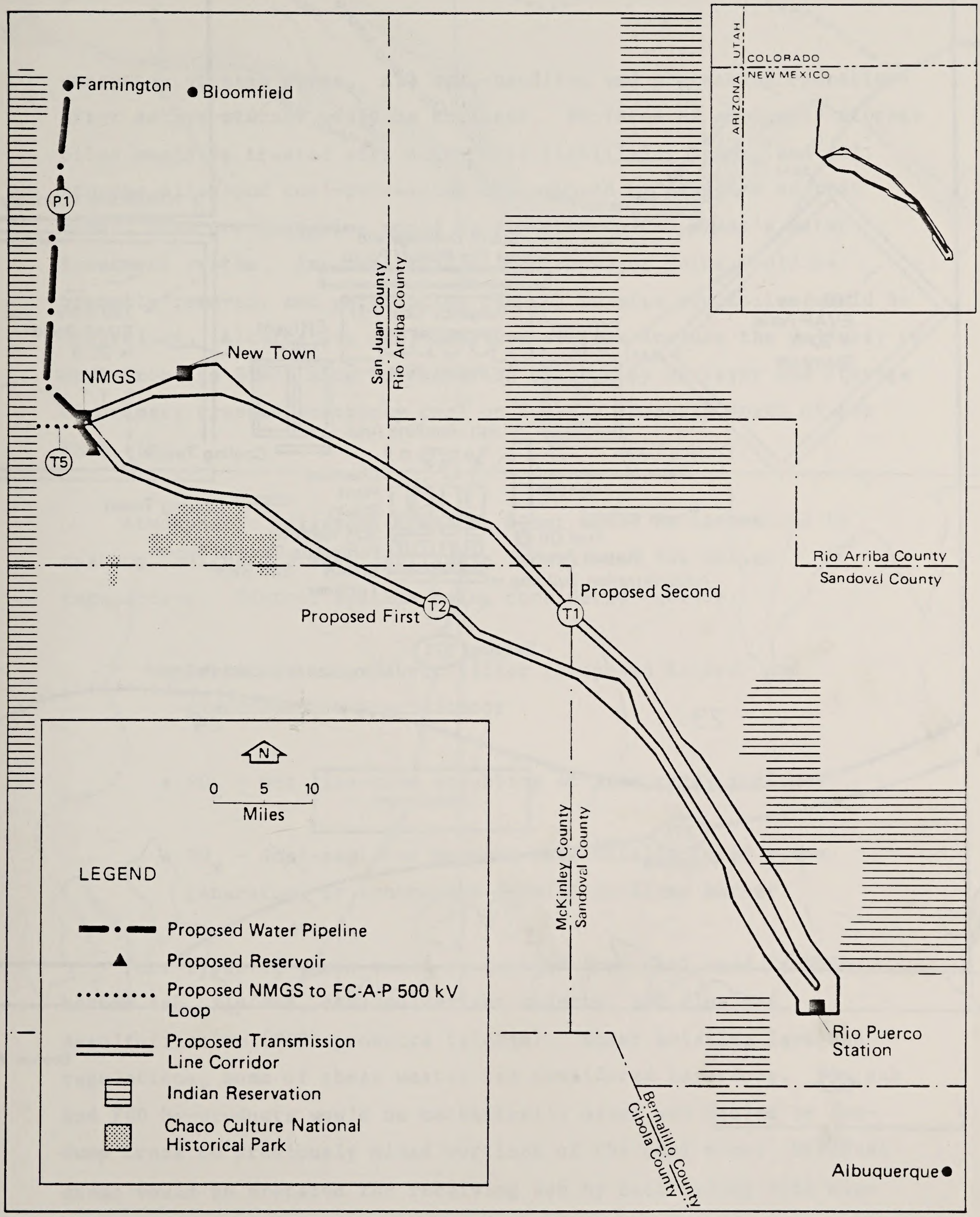
In order to accomplish these objectives and still provide the depth and background required for an analytic impact statement, this technical report has been prepared for the New Mexico Generating Station (NMGS) project. In this report, impacts that were not identified as significant but which are still considered important by the public or technical specialists are analyzed. Background material is provided for those issues and impacts that were considered necessary for the comparison of alternatives. Impacts that were not identified as significant or important by the public and by technical preparers are summarized, and reasons for their elimination from detailed analysis are discussed.

SUMMARY DESCRIPTION OF PROJECT COMPONENTS

Public Service Company of New Mexico (PNM) proposes to construct a 2000-megawatt (MW) coal-fired electric generation plant approximately 35 miles south of Farmington, New Mexico, in San Juan County (Map 1-1). The proposed NMGS, at ultimate development, would have four 500-MW generating units. Each generating unit would include a turbine generator area, coal pulverizer area, boiler area, particulate removal system, SO_2 removal system, and chimney stack. The proposed arrangement of these and other power plant components is shown in Figure 1-1. For the environmental analysis, it was assumed that commercial operation of the first 500-MW unit would begin in 1990 and that other units would start operating during the 1990s.

Coal for NMGS would be acquired through long-term contracts with Sunbelt Mining and Arch Minerals (Proposed Action) or other producers in the San Juan Basin (alternative coal supply). Coal acquired from a joint venture of Sunbelt and Arch Minerals would be supplied from surface mines (referred to as the Bisti mine in this analysis) in the immediate vicinity of the proposed plant site. Coal acquired from other producers in the San Juan Basin would be hauled from mines located as much as 30 miles from the proposed plant site. Coal required for NMGS would average 7.5 million tons per year, or a total of 300 million tons over the 40-year project life.

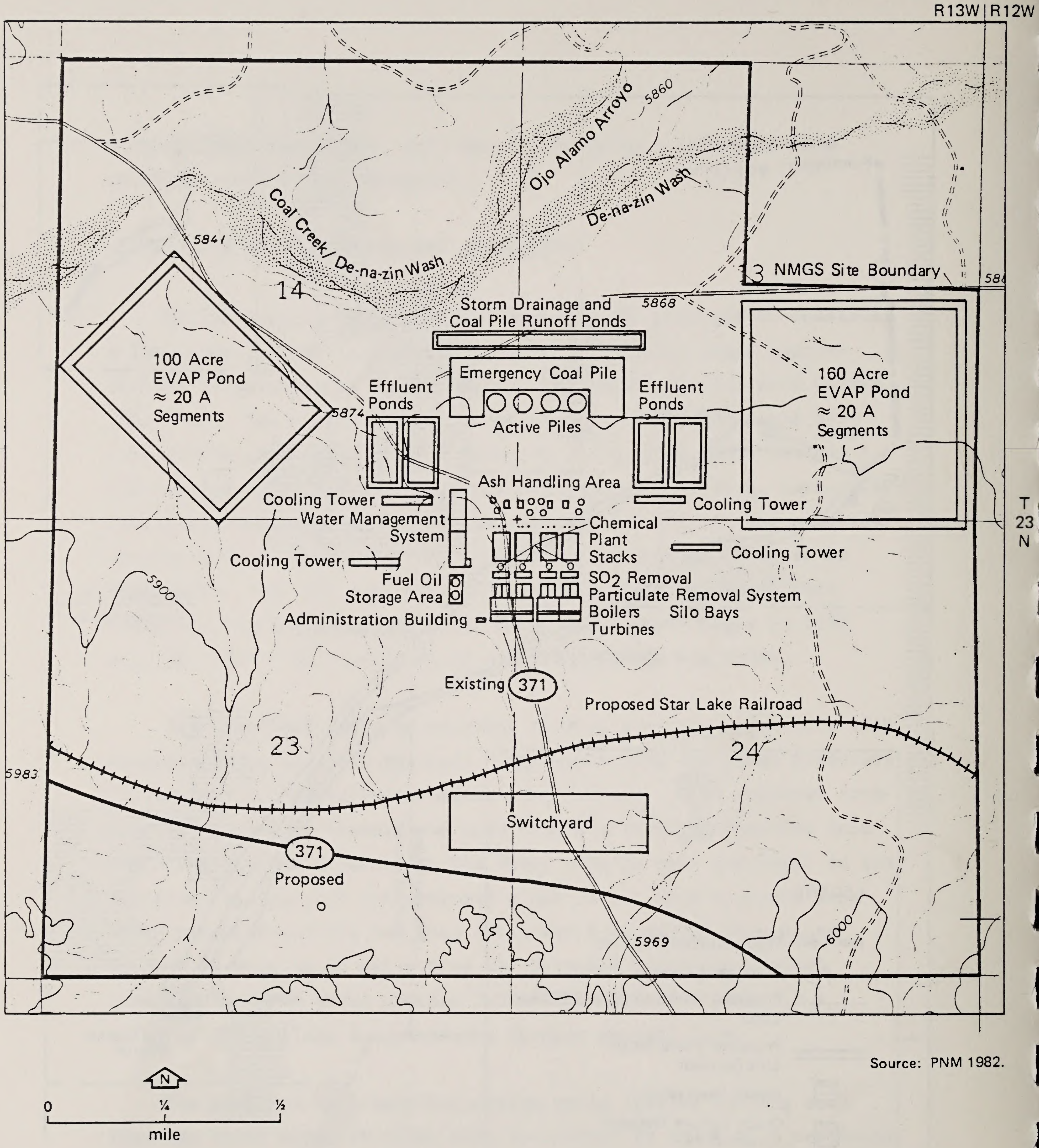
The proposed fuel-handling system would involve hauling coal from the Bisti mine (or other mine locations) by truck to a receiving facility located adjacent to the NMGS site. Coal would then be transferred via conveyor belt from the receiving station to active or



Note: For more information, see the location maps in Appendix G of the EIS.

Source: BLM 1982.

Map 1-1. GENERAL LOCATION OF PROPOSED ACTION



Source: PNM 1982.

Figure 1-1. STATION LAYOUT

emergency storage piles. All coal-handling and processing operations after active storage would be enclosed. Surfaces of emergency storage piles would be treated with a nontoxic stabilizing agent, and all storage piles and coal-processing areas would be designed so that runoff from precipitation would be diverted to the plant's water treatment system. Any coal spills from conveyor belts would be promptly removed, and percolation beneath on-site stockpiles would be controlled. Alternative fuel-handling systems include the delivery of coal from the Bisti mine to receiving station by conveyor and storage of primary crushed emergency coal on Sunbelt property north of the NMGS site.

Atmospheric emissions from the plant would be controlled by systems designed to meet applicable federal and New Mexico regulations. Control systems being considered include:

- Particulates - fabric filter (Proposed Action) and electrostatic precipitator
- SO_2 - wet limestone scrubbing or lime spray drying
- NO_x - dual-register burner, tangentially fired steam generator, or controlled-flow/split-flame burner

Four types of waste would be derived from coal used in NMGS: bottom ash, fly ash, coal pulverizer rejects, and flue gas desulfurization (FGD) products (sludge). Under existing laws and regulations, none of these wastes are considered hazardous. Fly ash and FGD by-products would be mechanically mixed and hauled by end-dump truck to previously mined portions of the coal mine. Disposal areas would be prepared for receiving ash by backfilling with mine overburden. Ash would then be dumped and spread in layers over the mine overburden. After the ash was placed and spread, it would be covered with layers of overburden and surface soil or topsoil and then a vegetative cover would be established. Bottom ash and pulverizer rejects would be collected for disposal in dewatering bins and then hauled by end-dump trucks for disposal into previously mined portions of the coal mine. Procedures for disposal would be the same as for fly ash.

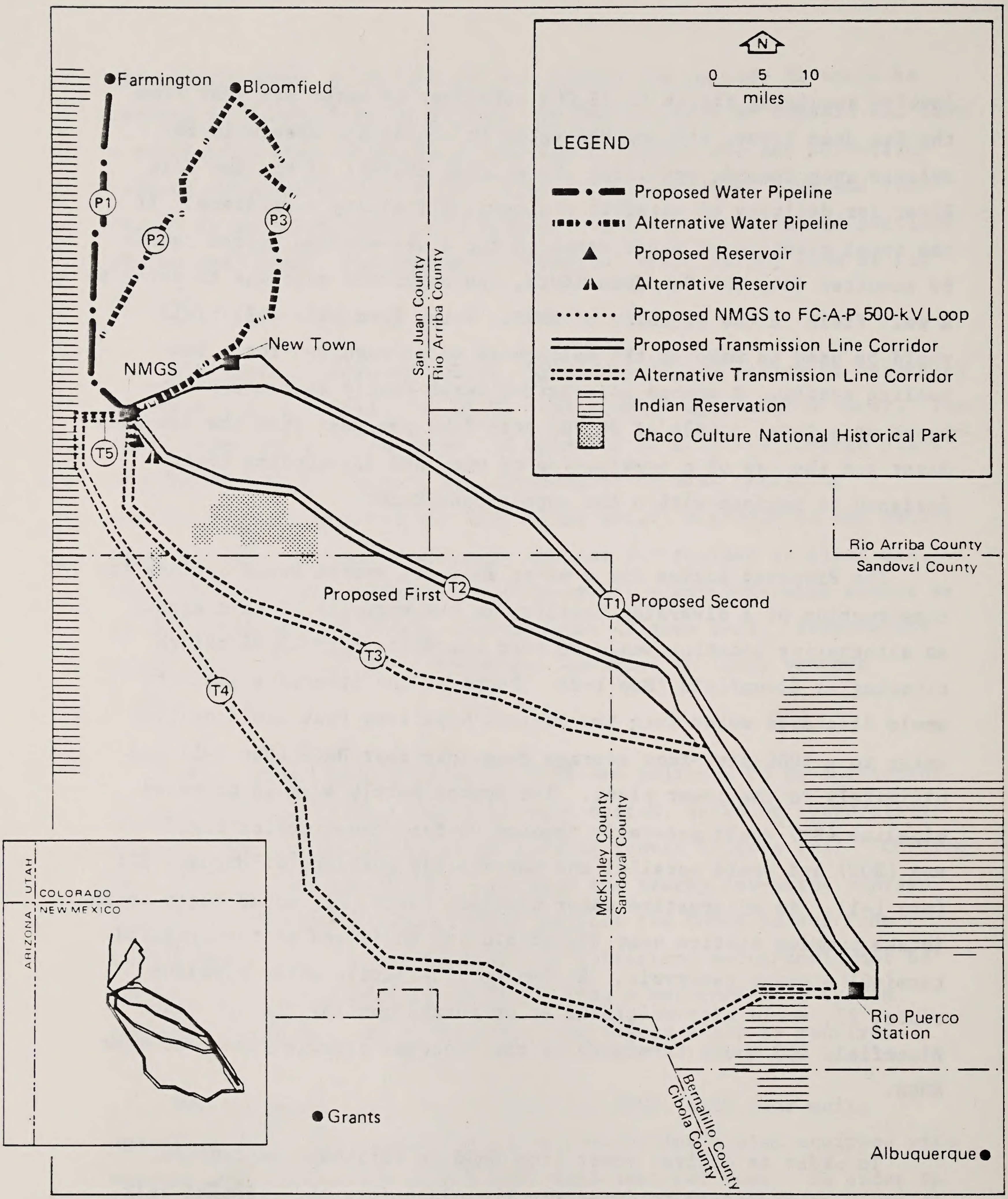
The water management system would contain all equipment necessary to treat and supply all the plant makeup water and potable water. The power plant would be designed and operated as a zero-discharge plant; wastewater would be reused by cascading it to uses requiring successively lower water quality. Used water, degraded to the extent that it could not be economically treated for further in-plant use, would be used for transport and disposal of plant-generated wastes or would be discharged to evaporation ponds (Figure 1-1). Evaporation ponds would be lined with impervious material to limit seepage losses.

Water supplies available for NMGS are believed to be sufficient to construct an all-wet heat-rejection system, based on evaporative cooling, and to use forced-draft cooling towers (Figure 1-1). Cooling-tower makeup water would be drawn from the nearby raw-water storage reservoir. The makeup water would replace the tower losses from evaporation, drift, and blowdown. If sufficient water could not be secured for a totally evaporative system, a water-cooling system employing both dry and conventional wet towers might be required.

The estimated water requirement for NMGS, with four units operating at rated capacity and a heat-rejection system equipped with wet-cooling towers, would be 35,000 acre-feet per year. In order to supply this quantity of water to NMGS, the Proposed Action would involve acquiring rights to 35,000 acre-feet of water per year from the San Juan River, storing the water in the Navajo Reservoir for release upon demand, and using the natural channel of the San Juan River for delivery of water to a diversion facility downstream. If the total quantity of water required for a wet-cooling system cannot be acquired from the San Juan River, the applicant proposes to develop a well field in the vicinity of NMGS. Water from this well field would be used to make up the balance of water required for a wet-cooling system. A second alternative water supply system would be based on a total supply of 20,000 acre-feet per year from the San Juan River and the use of a combination of wet- and dry-cooling towers designed to perform within the supply constraint.

The Proposed Action for a water delivery system would include the construction of a diversion facility in the vicinity of Farmington; an alternative location would be near the State Highway 44 bridge crossing at Bloomfield (Map 1-2). Pumps at the diversion facility would discharge water into two 36-inch pipelines that would deliver water to a 4000-acre-foot storage reservoir near NMGS (Map 1-1) and ultimately to the power plant. The approximately 40-mile proposed pipeline (P1) would generally require 90-foot construction rights-of-way (ROW) and would parallel the new and old portions of Highway 371 (Map 1-1). An alternative water pipeline route, P2, would begin at an intake pumping station near Bloomfield and would end at the proposed terminal storage reservoir. A 49-mile alternative water pipeline route, P3, would also originate at an intake pumping station near Bloomfield and would terminate at the proposed storage reservoir near NMGS.

In order to deliver power from NMGS to various load centers, it would be necessary to integrate the plant into the existing bulk



Note: For more information, see the location maps in Appendix G of the EIS.

Source: BLM 1982.

Map 1-2. GENERAL LOCATION OF ALTERNATIVES INCLUDING THE PROPOSED ACTION transmission systems of PNM and neighboring utilities. Thus the proposed transmission system would consist of a 500-kilovolt (kV) loop linking NMGS with PNM's approved 500-kV Four Corners-Ambrosia-Pajarito (FC-A-P) line, located approximately 5 miles west of NMGS, and two 500-kV lines linking NMGS with the Albuquerque distribution and load center at the proposed Rio Puerco Station (Map 1-1). The NMGS-Albuquerque system would be installed in phases: the 500-kV loop in 1990 with commencement of commercial operation of Unit 1, the first 500-kV line with Unit 2 in 1993, and the second 500-kV line with Unit 4 in 1998.

Four routes are considered technically and economically feasible for construction of the 500-kV transmission system. Route T2 is proposed for the first 500-kV line and route T1 is proposed for the second 500-kV line; routes T3 and T4 are alternatives to the Proposed Action. The total distance traversed would be similar for the two proposed and two alternative corridors: 101 miles (T2), 107 miles (T1), 105 miles (T3), and 126 miles (T4). With the exception of tower sites, the proposed 200-foot ROW could support other compatible land uses, such as grazing. PNM would keep the transmission line ROW closed and would patrol the line by helicopter each month. Lands disturbed by heavy equipment and temporary access roads would be restored to their original condition.

Table 1-1 displays construction work force estimates over time. Construction employment for station facilities would reach peaks of 1515 employees in 1987 and 1530 employees in 1992. Operations employment at station facilities would increase steadily, from 30 employees in 1989 to 900 employees in 1999 when all four units are expected to be on-line.

Table 1-1. NMGS CONSTRUCTION AND OPERATION EMPLOYMENT

Year	Intake Pipeline and Reservoir	500-kV Transmission Line	NMGS										Total Employment	Annual Change
			Construction					Operation						
			Unit 1	Unit 2	Unit 3	Unit 4	Total	Unit 1	Unit 2	Unit 3	Unit 4	Total		
1985	—	—	85	—	—	—	85	—	—	—	—	—	85	+85
1986	—	—	800	—	—	—	800	—	—	—	—	—	800	+715
1987	115	—	1515	—	—	—	1630	—	—	—	—	—	1630	+830
1988	295	104	1180	30	—	—	1505	—	—	—	—	—	1505	-125
1989	—	—	360	450	—	—	914	30	—	—	—	30	944	-560
1990	—	—	100	940	40	—	1080	200	—	—	—	200	1280	+336
1991	—	—	—	750	570	—	1320	250	—	—	—	250	1570	+290
1992	—	—	—	270	1260	—	1530	250	24	—	—	274	1804	+234
1993	—	—	—	105	955	30	1090	250	160	—	—	410	1500	-304
1994	—	78	—	—	325	435	838	250	200	30	—	480	1318	-182
1995	—	—	—	—	90	940	1030	250	200	200	—	650	1680	+362
1996	—	—	—	—	—	775	775	250	200	250	—	700	1475	-205
1997	—	—	—	—	—	255	255	250	200	250	24	724	979	-496
1998	—	—	—	—	—	95	95	250	200	250	160	860	955	-24
1999	—	—	—	—	—	—	0	250	200	250	200	900	900	-55

Source: PNM 1980, unpublished data.

According to PNM (unpublished data, 1980), estimated construction employment skill requirements would be as follows:

Skill	Percent of Total Construction Work Force
Boilermakers	9.4
Pipefitters	14.2
Electricians	14.4
Carpenters	5.6
Ironworkers	10.0
Operators	10.0
Laborers	9.0
Teamsters	4.1
Cement masons	0.8
Millwrights	3.3
Insulators	4.0
Sheetmetal workers	1.1
Painters	1.2
Others	0.5
Supervision	12.4

The above estimates are averaged for construction of all four units.

SAN JUAN BASIN ACTION PLAN OVERVIEW AND RELATIONSHIP OF THE NMGS EIS TO ACTIONS INCLUDED IN THE PLAN

The proposed site for the NMGS is located in the San Juan Basin of northwestern New Mexico. The Bureau of Land Management (BLM) is responsible for the management of much of the land and mineral resources in this area, and currently has six separate but interrelated proposals under consideration within the basin. In order to respond to these, the BLM has developed a San Juan Basin Action Plan (SJBAP). This plan provides for the organizational arrangements whereby the environmental analyses and decision making can be implemented in a timely and efficient manner. The plan describes the process for preparation of three site-specific EISs (including the NMGS EIS) and three Environmental Assessments (EAs):

- Coal Preference Right Lease Applications (EA)
- San Juan River Regional Coal Leasing (EIS)
- Wilderness Study Areas (WSAs) (EIS)
- New Mexico Generating Station (EIS)
- Ute Mountain Land Exchange (EA)
- Bisti Coal Lease Exchange (EA)

In addition to these documents, the action plan provides for the preparation of a Cumulative Overview (CO). The CO is intended to focus on the cumulative impacts that would result from the proposed actions analyzed in the EISs and EAs listed above and therefore to facilitate public review and decision making. As a result of this organization, the impact analysis in the NMGS EIS and technical background reports concentrates on the impacts expected to result from the specific NMGS components proposed. The cumulative impacts expected to result from the proposed NMGS, in addition to the cumulative impacts of other proposals to be developed in the same time period, are described in the CO.

BASELINE CONDITIONS ASSUMED FOR THE NMGS TECHNICAL REPORT IMPACT ANALYSES

The site-specific impact analysis for this technical report was based on the affected environment and available resources that would be existing at the time of construction and operation of the NMGS facility. Since construction at the NMGS facility would not begin until 1985, certain assumptions regarding project development in the San Juan Basin were necessary. Two levels of project development were considered, along with criteria for each, in developing a status for the various non-SJBAP actions proposed for the San Juan Basin area.

- Baseline 1 - The projects considered in this level of development are those that have approval and are to be built or under construction in 1985. This level represents the projected existing environment without the proposals included in the SJBAP.

- Baseline 2 - The projects considered in this level are in some phase of the application stage. In this level, Baseline 1 projects are added to any projects in Baseline 2 along with any revision in resource production or uses (e.g., coal).

Where differences in Baselines 1 and 2 affect the results of impact analyses, discussion is provided. If no differences are identified, it should be assumed that consideration of the two different baselines did not alter the impact analyses.

A complete list of projects and comprehensive location maps for Baselines 1 and 2 are provided in Appendix C of the NMGS EIS.

ORGANIZATION OF THE REPORT

Section 2.0 of this technical report describes the assumptions and methodological approach used in the assessment of potential impacts of the Proposed Action on the affected environment. In addition, Section 2.0 contains a definition of the study area and identification of data sources.

Section 3.0, Affected Environment, contains baseline data on existing conditions in the study area, as well as projections of future conditions without the Proposed Action. Information on historical trends is presented where it is useful in providing a basis for predicting most likely future trends. The description of projected future trends takes into consideration the changes in the environment that are expected to occur as a result of the projects identified in Baseline 1. This provides a reasonable estimate of the future existing environment against which the potential impacts of the Proposed Action and alternatives can be assessed.

Section 4.0 describes the potential effects of implementing the Proposed Action and alternatives. Impacts identified are measured against indicators of significance in order to estimate the importance of the impact to the affected human environment. (Potential impacts associated with alternatives to the Proposed Action are compared in Section 9.0.)

In Section 5.0, mitigation measures are suggested. These measures would help to alleviate the potentially significant adverse impacts or enhance the beneficial impacts identified in the Section 4.0 analysis. Those potentially adverse impacts for which no appropriate mitigation measures have been suggested are discussed in Section 6.0 as "unavoidable adverse impacts."

2.0
FRAMEWORK FOR ANALYSIS

SOILS

Geographic Area of Influence

Direct impacts to the soils resource would occur primarily on areas directly disturbed (e.g., NMGS site, pipeline and transmission line ROWs and associated surface facilities, reservoir site, and borrow areas) during construction, operation, and maintenance of the Proposed Action or alternatives.

Indirect impacts to the soils resource would result primarily from increased off-road vehicle (ORV) access to previously inaccessible areas. Construction of new ROWs (e.g., pipeline and transmission lines) would allow some previously inaccessible areas to be accessible to ORVs. The degree and areal extent of such disturbances are unknown, but would probably be limited to about 5 miles on each side of new ROWs.

Indicators of Impact Significance

Indicators of impact significance included the degree and areal extent of disturbances, erosion susceptibility, and reclamation potential of the areas that would be directly affected during construction, operation, and maintenance of the various project components. Impacts to the soils resource were considered significant if there is a high probability that soil erosion would not be held to acceptable levels and disturbed areas would not be able to revegetate. An "acceptable" soil erosion level is defined as the amount of soil loss that would not significantly affect the long-term productivity and stability of disturbed areas. Findings were based on analyses of soils and terrain traversed and on erosion control and reclamation measures presented in the project description (see Chapter 1.0 of the EIS).

Determination of potential problem soil areas was accomplished by analyzing published soil maps and surveys and through discussions with applicable resource agency personnel (Soil Conservation Service and BLM). Construction and erosion control/reclamation measures presented in the project description were assessed as to their adequacy for protecting against significant impacts to the soils resource. Erosion control and reclamation measures were proposed for consideration of inclusion in the project description or BLM ROW stipulations when findings from the analysis warranted.

Methods for Data Collection

A thorough literature search of existing soils data within the applicable portion of the San Juan Basin region was conducted. The applicable soils data sources used include Soil Conservation Service (SCS) soil surveys/publications and SCS Form 5, Soil Interpretation Tables; SCS/New Mexico State University, Agricultural Experiment Station, research reports; and a PNM-contracted soil survey for the NMGS site.

An aerial reconnaissance and partial ground survey of proposed and alternate project components was performed. SCS and BLM personnel were contacted for additional soils information.

Interrelationships with Baselines 1 and 2

Consideration of the energy and resource-related projects in Baselines 1 and 2 generally does not change the potential soils resource impacts attributable to the NMGS project. The one exception is the interrelationship between the NMGS project and the Navajo Indian Irrigation Project (NIIP). Potential impacts are discussed under the applicable project components.

PRIME AND UNIQUE FARMLANDS

Geographic Area of Influence

Significant impacts to Prime or Unique Farmlands would occur only on areas that would be taken out of production by surface facilities associated with the Proposed Action or alternatives (e.g., NMGS, San Juan River intake, pipeline pump stations, reservoir site, or transmission towers/substations). This is based on the premise that topsoiling would be performed on all temporarily disturbed irrigated cropland areas.

Indicators of Impact Significance

Impacts were considered significant if any Prime or Unique Farmlands would be taken out of production by surface facilities associated with the Proposed Action or alternatives.

Methods for Data Collection

Appropriate SCS offices were contacted for information regarding the locations of Prime and Unique Farmlands in the project area. Data sources included the Prime Farmland list (by soil mapping unit) for San Juan County and locational descriptions provided by SCS personnel. Additionally, SCS/New Mexico State University, Agricultural Experiment Station, research reports were used to ascertain potential Prime Farmland areas within the proposed and alternate transmission corridors.

Interrelationships with Baselines 1 and 2

Consideration of the energy and resource-related projects in Baselines 1 and 2 generally does not change the potential impacts to Prime and Unique Farmlands. The one exception is the interrelationship between the NMGS project and the NIIP. Potential impacts are discussed under the applicable project components.

3.0
AFFECTED ENVIRONMENT

SOILS

Soils maps (1:24,000 and 1:62,500 scales) for the proposed NMGS site, proposed and alternate main water pipelines, and proposed and alternate terminal storage reservoirs are available for review at the BLM New Mexico State Office in Santa Fe. Maps (1:250,000 scale) showing the soils identified within the proposed and alternate transmission corridors are also available for review at that location.

The soils in the San Juan Basin that would potentially be affected by the proposed NMGS project or alternatives have resulted primarily from erosion and weathering of sedimentary parent materials (e.g., sandstone, shale, and siltstone). Surface textures are primarily sandy, but range from fine sand to clay. Many of the identified soils are moderately to highly susceptible to wind-induced soil erosion, while water erosion susceptibility is generally low to moderate.

Overall, the soils identified in the project area are not very productive because of low available moisture, low organic matter content, and undesirable physical and chemical characteristics.

Proposed NMGS Site

The proposed NMGS site is within the San Juan River Valley Mesas and Plateaus portion of the Western Range and Irrigated Region (SCS 1978a). The area is underlain by deep Tertiary fill resting on rocks of Late Cretaceous age. Annual precipitation generally ranges from 6 to 10 inches at the site. Five different soil associations were identified at the proposed NMGS site. Table 1 lists and characterizes the identified soils.

The soils identified within the proposed NMGS site are primarily deep, and well to somewhat excessively drained. Surface textures of the soils identified at the site range from fine sand to clay. These soils are forming in alluvial, eolian, and residual materials derived primarily from sandstone, shale, and siltstone on mesas, plateaus, intermittent drainageways, and escarpments. The terrain slopes range mainly from nearly level to moderately sloping, but a small, steep area of Badland-Rock Outcrop is present on the south-central portion of the site. Badland-Rock Outcrop comprises approximately 2 percent of the total site area. Topsoil availability at the site is limited due to generally shallow soil surface layers, and the majority (approximately 80 percent) of the existing topsoil is of fair to poor quality due to undesirable surface textures (e.g., too sandy or clayey) or excess salt/sodium. These soils are characterized by a low to high wind erosion hazard, and a primarily moderate water erosion hazard. Sandy-textured soils such as Sheppard, Fruitland, Stumble, and Duneland are highly susceptible to wind erosion. Soils which contain a high percentage of clay or silt particles are normally the most susceptible to water erosion, but unstabilized sandy soils occurring in drainages (e.g., Riverwash) are also highly susceptible to water erosion. The soils at the site are mildy to strongly alkaline. Shrink-swell potential of the identified soils is primarily low to moderate, but the Notal soil has a high shrink-swell

Table 1. CHARACTERISTICS OF THE SOILS IDENTIFIED AT THE PROPOSED NMGS

Soil Association and Description[1]	Approximate Acreage	Soil Series	Depth to Bedrock (inches)	Slope (%)	Depth to High Water Table (feet)	Soil Reaction (pH)	Salinity (mmhos/cm)	Hydrologic Group	WEG Class	'K'	'T'	Comments
Shiprock-Sheppard-Huerfano: Deep to shallow, well to somewhat excessively drained, fine sandy loam, fine sand, loamy fine sand, sandy clay loam, sandy loam, and clay loam soils. These soils formed on nearly level to strongly sloping mesas, plateaus, and upland valley bottoms from sandy alluvial and eolian materials derived from sandstone; and from alluvium, residuum, and loess derived from shale and siltstone.	911	Shiprock	60+	0-8	>6	7.4-9.0	<4	B	2,3	.24	5	Moderate to high wind erosion hazard, moderate to low water erosion hazard, good to poor topsoil, 6-10 inch precipitation zone. These soils are mildly to strongly alkaline (Huerfano portion is sodium affected), and shrink-swell potential is low to moderate.
		Sheppard	60+	1-12	>6	7.4-8.4	<2	A	1	.10	5	
		Huerfano	10-20	0-3	>6	7.9-9.0	>4	D	3,4L	.32	1	
Turley-Fruitland-Blancot: Deep, well drained, clay loam, loam, fine sandy loam, and sandy loam soils formed on level to moderately steep alluvial fans, upland valley sideslopes, and mesas from mixed alluvium derived from sandstone and shale.	882	Turley	60+	0-5	>6	7.4-9.0	2-4	B	3,4L	.37	5	Low to high (Fruitland portion) wind erosion hazard, moderate water erosion hazard, fair to good topsoil, 6-10 inch precipitation zone. These soils are mildly to strongly alkaline (calcareous), and shrink-swell potential is low to moderate.
		Fruitland	60+	0-30	>6	7.4-8.4	<4	B	1,3,5	.28	5	
		Blancot	60+	0-5	>6	7.9-9.0	2-4	B	3,5	.28	5	
Stumble-Notal-Huerfano: Deep, somewhat excessively and well drained, loamy sand, loam, sandy clay loam, silty clay loam, clay, silty clay, and sandy loam soils formed on level to moderately sloping alluvial fans, upland valley sideslopes and bottoms, drainageways, and mesas from alluvium and residuum derived from sandstone, shale, and siltstone.	439	Stumble	60+	0-8	>6	7.9-9.0	<4	A	2,5	.24	5	Low to high (Stumble portion) wind erosion hazard, moderate water erosion hazard, poor to fair topsoil, 6-10 inch precipitation zone. These soils are moderately to strongly alkaline (Notal-Huerfano portion is sodium affected), and shrink-swell potential is low to high (Notal portion).
		Notal	60+	0-2	>6	7.9-9.0	4-8	D	4L	.37	5	
		Huerfano	10-20	0-3	>6	7.9-9.0	>4	D	3,4L	.32	1	
Riverwash-Duneland: Deep, poorly to excessively drained, unstabilized sandy, silty, clayey, and gravelly alluvium occurring on level and nearly level floodplains, streambeds, and arroyos; and unstabilized eolian sand occurring on nearly level to steep mesas, plateaus, and major drainageways.	114	Riverwash	60+	0-2	0-2[2]	NA	NA	D	NA	NA	NA	Low and high (Duneland portion) wind erosion hazard, high (Riverwash portion) and low water erosion hazard, poor topsoil, 6-10 inch precipitation zone. Riverwash portion is frequently flooded, and shrink-swell potential is low.
		Duneland	60+	2-40	>6	NA	NA	A	1	.15	5	
Badland-Rock Outcrop: Nonstony, moderately sloping to extremely steep barren shale uplands that are dissected by deep intermittent drainageways and gullies; and barren sandstone exposures on moderately sloping to extremely steep ridges, benches, and escarpments.	54	Badland	0	5-80	>6	NA	NA	D	NA	NA	NA	Wind erosion hazard is low, Badland portion is susceptible to water erosion, topsoil is generally nonexistent (i.e., poor topsoil), 6-10 inch precipitation zone. Potential runoff on Badland portion is very rapid.
		Rock Outcrop	0	5-80	>6	NA	NA	D	NA	NA	NA	
(Total Acreage)	(2400)											

NA = Not available or not applicable.

[1] Sources:
(1) Buchanan, B. 1978. Soils field research, soils map. Prepared (under contract) for Public Service Company of New Mexico. Albuquerque, New Mexico.
(2) U.S. Soil Conservation Service (SCS). 1980. Soil survey of San Juan County, New Mexico, eastern part.
(3) Applicable SCS Form 5 - Soil Interpretation Tables.

[2] December and January only (i.e., water table is lower most of year).

potential. These soils are used primarily for livestock grazing and wildlife habitat.

Water Supply System

Proposed Main Water Pipeline P1. Pipeline route P1 is within the San Juan River Valley Mesas and Plateaus portion of the Western Range and Irrigated Region (SCS 1978a). Annual precipitation along P1 is usually about 8 inches. Twenty-three different soil phases, series, associations, or complexes were identified along this route. Table 2 lists (by mileposts) and characterizes the identified soils.

The soils identified along the pipeline route P1 are primarily deep and well to somewhat excessively drained. Surface textures range from fine sand to clay. These soils are forming in alluvial, eolian, and residual materials derived primarily from sandstone, shale, and siltstone on mesas, plateaus, drainageways, valley bottoms, valley sides, and alluvial fans. The terrain slopes range mainly from nearly level to moderately sloping, although a small area of moderately sloping to steep Badland would be traversed near Moncisco Mesa (between MP 15.45-16.8). Approximately 5.1 miles of Badland (nonstony, barren shale) and Badland-Rock Outcrop would be traversed by this pipeline route. Topsoil availability along this pipeline route is limited due to generally shallow soil surface layers, and the majority of the existing topsoil is of fair to poor quality due to undesirable surface textures (e.g., too sandy or clayey) or excess salt/sodium. The Blackston (mileposts [MP] 0.05-0.10; adit/shaft portion), Persayo (MP 0.1-0.6; 0.65-0.75; 0.85-2.70; and 2.85-3.30) and Muff (MP 17.30-19.2; 22.85-22.90; and 23.40-23.50) soils are difficult to reclaim if the topsoil is removed and not replaced. Susceptibility to wind-induced soil erosion ranges from low to high, but it is primarily moderate to high. Susceptibility to water-induced

Table 2. CHARACTERISTICS OF THE SOILS IDENTIFIED ALONG MAIN WATER PIPELINE ROUTE P1

Milepost	Map Symbol	Soil Phase, Series, Association, or Complex and Description[1]	Soil Phase or Series	Depth to Bedrock (inches)	Slope (%)	Depth to High Water Table (feet)	Soil Reaction (pH)	Salinity (mmhos/cm)	Hydro-logic Group	WEG Class	'K'	'T'	Comments
0.0-0.05	Wr	Werlog: Deep, somewhat poorly drained, loam and clay loam soils formed on level and nearly level floodplains and terraces from alluvium derived primarily from sandstone and shale. Stratified sand, gravel, and cobbles below 60 inches.	Werlog	60+	0-1	2-5	7.9-9.0	2-4	C	8	.37	5	Low wind erosion hazard, moderate water erosion hazard, fair topsoil (too clayey), 8 inch precipitation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel, not well suited to urban development (wetness).
0.05-0.10[2]	HA	Haplargids-Blackston-Torriorthents: Shallow to deep, well to excessively drained, cobbly sandy loam, cobbly sandy clay loam, gravelly loam, gravelly clay loam, cobbly loam, and clay loam soils formed on moderately sloping to steep terraces, mesas, and plateaus from alluvium derived from mixed sources.	Haplargids Blackston Torriorthents	10-60+ 60+ 10-20	8-50 8-40 8-50	NA >6 NA	NA 7.9-8.4 NA	NA 2-4 NA	NA B NA	NA 5 NA	NA .17 NA	NA 1 NA	Low wind erosion hazard, low to high water erosion hazard, poor topsoil (area reclaim), 9 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.
0.10-0.20[2]	BC	Badland-Rock Outcrop-Persayo: Shallow, well drained, clay loam, and silty clay loam soils formed on steep hills, ridges, and breaks in material derived primarily from shale. Includes steep, nonstony, barren shale on uplands that are dissected by deep intermittent drainageways and gullies, and barren sandstone outcrops on steep to very steep ridges, benches, and escarpments.	Badland Rock Outcrop Persayo	0 0 10-20	30-50 40-70 30-40	>6 >6 >6	NA NA 7.9-9.0	NA NA <8	NA NA D	NA NA 4L	NA NA .37	NA NA 1	Moderate wind and water erosion hazard, poor topsoil (area reclaim), 8 inch precipitation zone. Shrink-swell potential is moderate, high corrosion hazard to uncoated steel.
0.20-0.60	FA	Farb-Persayo-Rock Outcrop: Very shallow to shallow, excessively and well drained, fine sandy loam, sandy clay loam, clay loam, and silty clay loam soils formed on gently sloping to moderately steep hills and breaks from residuum derived from sandstone and shale. Includes barren sandstone outcrops on strongly sloping to moderately steep benches, ridges, and breaks.	Farb Persayo Rock Outcrop	5-20 10-20 0	3-30 3-30 10-30	>6 >6 >6	7.4-8.4 7.9-9.0 NA	<2 <8 NA	D D NA	3 4L NA	.32 .37 NA	1 1 NA	Moderate wind and water erosion hazard, poor topsoil (Persayo portion-area reclaim), 8 inch precipitation zone. Shrink-swell potential is low to moderate, low to high corrosion hazard to uncoated steel.
0.60-0.65	Ay	Avalon: Deep, well drained, loam soils formed on level to gently sloping mesas and plateaus from alluvial and eolian materials derived primarily from sandstone and shale.	Avalon	60+	0-3	>6	7.9-8.4	2-8	B	4L	.43	3	Moderate wind erosion hazard, high water erosion hazard, fair topsoil (excess salt), 8 inch precipitation zone. Shrink-swell potential is low, soil is slightly saline, high corrosion hazard to uncoated steel.
0.65-0.75	FA	Farb-Persayo-Rock Outcrop: Very shallow to shallow, excessively and well drained, fine sandy loam, sandy clay loam, clay loam, and silty clay loam soils formed on gently sloping to moderately steep hills and breaks from residuum derived from sandstone and shale. Includes barren sandstone outcrops on strongly sloping to moderately steep benches, ridges, and breaks.	Farb Persayo Rock Outcrop	5-20 10-20 0	3-30 3-30 10-30	>6 >6 >6	7.4-8.4 7.9-9.0 NA	<2 <8 NA	D D NA	3 4L NA	.32 .37 NA	1 1 NA	Moderate wind and water erosion hazard, poor topsoil (Persayo portion-area reclaim), 8 inch precipitation zone. Shrink-swell potential is low to moderate, low to high corrosion hazard to uncoated steel.
0.75-0.85	Ay	Avalon: Deep, well drained, loam soils formed on level to gently sloping mesas and plateaus from alluvial and eolian materials derived primarily from sandstone and shale.	Avalon	60+	0-3	>6	7.9-8.4	2-8	B	4L	.43	3	Moderate wind erosion hazard, high water erosion hazard, fair topsoil (excess salt), 8 inch precipitation zone. Shrink-swell potential is low, soil is slightly saline, high corrosion hazard to uncoated steel.

Table 2. CHARACTERISTICS OF THE SOILS IDENTIFIED ALONG MAIN WATER PIPELINE ROUTE P1 (continued)

Milepost	Map Symbol	Soil Phase, Series, Association, or Complex and Description[1]	Soil Phase or Series	Depth to Bedrock (inches)	Slope (%)	Depth to High Water Table (feet)	Soil Reaction (pH)	Salinity (mmhos/cm)	Hydrologic Group	WEG Class	'K'	'T'	Comments
0.85-1.95	FA	Farb-Persayo-Rock Outcrop: Very shallow to shallow, excessively and well drained, fine sandy loam, sandy clay loam, clay loam, and silty clay loam soils formed on gently sloping to moderately steep hills and breaks from residuum derived from sandstone and shale. Includes barren sandstone outcrops on strongly sloping to moderately steep benches, ridges, and breaks.	Farb Persayo Rock Outcrop	5-20 10-20 0	3-30 3-30 10-30	>6 >6 >6	7.4-8.4 7.9-9.0 NA	<2 <8 NA	D D NA	3 4L NA	.32 .37 NA	1 1 NA	Moderate wind and water erosion hazard, poor topsoil (Persayo portion-area reclaim), 8 inch precipitation zone. Shrink-swell potential is low to moderate, low to high corrosion hazard to uncoated steel.
1.95-2.70	FX	Fruitland-Persayo-Sheppard: Deep and shallow, well to somewhat excessively drained, sandy loam, fine sandy loam, clay loam, loamy fine sand, and fine sand soils formed on moderately sloping to moderately steep hills, mesas, plateaus, fans, and breaks from alluvium, residuum, and eolian materials derived from sandstone and shale.	Fruitland Persayo Sheppard	60+ 10-20 60+	5-30 5-30 5-30	>6 >6 >6	7.4-8.4 7.9-9.0 7.9-8.4	<4 <8 <2	B D A	3 4L 2	.24 .37 .15	5 1 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor (Persayo portion-area reclaim), 8 inch precipitation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
2.7-2.85	Av	Avalon: Deep, well drained, sandy loam, and fine sandy loam soils formed on gently sloping mesas and plateaus from alluvial and eolian materials derived primarily from sandstone and shale.	Avalon	60+	2-5	>6	7.9-8.4	2-8	B	3	.37	3	Moderate wind and water erosion hazard, topsoil is fair (excess salt), 8 inch precipitation zone. Shrink-swell potential is low, soil is slightly saline, high corrosion hazard to uncoated steel.
2.85-3.05	FX	Fruitland-Persayo-Sheppard: Deep and shallow, well to somewhat excessively drained, sandy loam, fine sandy loam, clay loam, loamy fine sand, and fine sand soils formed on moderately sloping to moderately steep hills, mesas, plateaus, fans, and breaks from alluvium, residuum, and eolian materials derived from sandstone and shale.	Fruitland Persayo Sheppard	60+ 10-20 60+	5-30 5-30 5-30	>6 >6 >6	7.4-8.4 7.9-9.0 7.9-8.4	<4 <8 <2	B D A	3 4L 2	.24 .37 .15	5 1 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor (Persayo portion-area reclaim), 8 inch precipitation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
3.05-3.15	BC	Badland-Rock Outcrop-Persayo: Shallow, well drained, clay loam, and silty clay loam soils formed on steep hills, ridges, and breaks in material derived primarily from shale. Includes steep, nonstony, barren shale on uplands that are dissected by deep intermittent drainageways and gullies, and barren sandstone outcrops on steep to very steep ridges, benches, and escarpments.	Badland Rock Outcrop Persayo	0 0 10-20	30-50 40-70 30-40	>6 >6 >6	NA NA 7.9-9.0	NA NA <8	NA NA D	NA NA 4L	NA NA .37	NA NA 1	Moderate wind and water erosion hazard, poor topsoil (area reclaim), 8 inch precipitation zone. Shrink-swell potential is moderate, high corrosion hazard to uncoated steel.
3.15-3.30	FX	Fruitland-Persayo-Sheppard: Deep and shallow, well to somewhat excessively drained, sandy loam, fine sandy loam, clay loam, loamy fine sand, and fine sand soils formed on moderately sloping to moderately steep hills, mesas, plateaus, fans, and breaks from alluvium, residuum, and eolian materials derived from sandstone and shale.	Fruitland Persayo Sheppard	60+ 10-20 60+	5-30 5-30 5-30	>6 >6 >6	7.4-8.4 7.9-9.0 7.9-8.4	<4 <8 <2	B D A	3 4L 2	.24 .37 .15	5 1 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor (Persayo portion-area reclaim), 8 inch precipitation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
3.30-3.65	Sd	Sheppard-Mayqueen-Shiprock: Deep, somewhat excessively and well drained, loamy fine sand, fine sand, and fine sandy loam soils formed on level to moderately sloping mesas and plateaus from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Sheppard Mayqueen Shiprock	60+ 60+ 60+	5-8 2-8 0-5	>6 >6 >6	7.9-8.4 7.9-8.4 7.4-8.4	<2 <2 <2	A B B	2 2 3	.15 .24 .24	5 5 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to good, 8 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.

Table 2. CHARACTERISTICS OF THE SOILS IDENTIFIED ALONG MAIN WATER PIPELINE ROUTE P1 (continued)

Milepost	Map Symbol	Soil Phase, Series, Association,[1] or Complex and Description	Soil Phase or Series	Depth to Bedrock (inches)	Slope (%)	Depth to High Water Table (feet)	Soil Reaction (pH)	Salinity (mmhos/cm)	Hydrologic Group	WEG Class	'K'	'T'	Comments
3.65-3.90	Av/Ax	Avalon: Deep, well drained, sandy loam, fine sandy loam, and loam soils formed on gently to moderately sloping mesas and plateaus from alluvial and eolian materials derived primarily from sandstone and shale.	Avalon	60+	2-8	>6	7.9-8.4	2-8	B	3	.37	3	Moderate wind and water erosion hazard, topsoil is fair (excess salt), 8 inch precipitation zone. Shrink-swell potential is low, soil is slightly saline, high corrosion hazard to uncoated steel.
3.9-4.0	Sd	Sheppard-Mayqueen-Shiprock: Deep, somewhat excessively and well drained, loamy fine sand, fine sand, and fine sandy loam soils formed on level to moderately sloping mesas and plateaus from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Sheppard Mayqueen Shiprock	60+ 60+ 60+	5-8 2-8 0-5	>6 >6 >6	7.9-8.4 7.9-8.4 7.4-8.4	<2 <2 <2	A B B	2 2 3	.15 .24 .24	5 5 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to good, 8 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.
4.0-4.35	Av/Ax	Avalon: Deep, well drained, sandy loam, fine sandy loam, and loam soils formed on gently to moderately sloping mesas and plateaus from alluvial and eolian materials derived primarily from sandstone and shale.	Avalon	60+	2-8	>6	7.9-8.4	2-8	B	3	.37	3	Moderate wind and water erosion hazard, topsoil is fair (excess salt), 8 inch precipitation zone. Shrink-swell potential is low, soil is slightly saline, high corrosion hazard to uncoated steel.
4.35-6.0	Sd/So/Sm	Shiprock-Sheppard-Mayqueen: Deep, somewhat excessively and well drained, loamy fine sand, fine sand, fine sandy loam, and sandy loam soils formed on level to moderately sloping mesas and plateaus from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Shiprock Sheppard Mayqueen	60+ 60+ 60+	0-5 5-8 2-8	>6 >6 >6	7.4-8.4 7.9-8.4 7.9-8.4	<2 <2 <2	B A B	3 2 2	.24 .15 .24	5 5 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is good to poor, 8 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.
6.0-6.25	Ax	Avalon: Deep, well drained, sandy loam, and loam soils formed on moderately sloping mesas and plateaus from alluvial and eolian materials derived primarily from sandstone and shale.	Avalon	60+	5-8	>6	7.9-8.4	2-8	B	3	.37	3	Moderate wind and water erosion hazard, topsoil is fair (excess salt), 8 inch precipitation zone. Shrink-swell potential is low, soil is slightly saline, high corrosion hazard to uncoated steel.
6.25-13.0	Sm/Sd/So	Shiprock-Sheppard-Mayqueen: Deep, somewhat excessively and well drained, loamy fine sand, fine sand, fine sandy loam, and sandy loam soils formed on level to moderately sloping mesas and plateaus from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Shiprock Sheppard Mayqueen	60+ 60+ 60+	0-5 5-8 2-8	>6 >6 >6	7.4-8.4 7.9-8.4 7.9-8.4	<2 <2 <2	B A B	3 2 2	.24 .15 .24	5 5 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is good to poor, 8 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.
13.0-13.05	Da	Doak: Deep, well drained, loam, and clayey loam soils formed on level and nearly level mesas, plateaus, and terraces from alluvium derived primarily from sandstone and shale.	Doak	60+	0-1	>6	7.4-8.4	<2	B	5	.37	5	Low wind erosion hazard, moderate water erosion hazard, topsoil is fair (too clayey), 8 inch precipitation zone. Shrink-swell potential is low to moderate, low soil strength, high corrosion hazard to uncoated steel.
13.05-13.10	Sm	Shiprock: Deep, well drained, fine sandy loam, and sandy loam soils formed on level and nearly level mesas and plateaus from alluvial and eolian materials derived primarily from sandstone and shale.	Shiprock	60+	0-2	>6	7.4-8.4	<2	B	3	.24	5	Moderate wind and water erosion hazard, good topsoil, 8 inch precipitation zone. Shrink-swell potential is low, highly corrosive to uncoated steel.
13.10-13.15	Av	Avalon: Deep, well drained, sandy loam, and fine sandy loam soils formed on gently sloping mesas and plateaus from alluvial and eolian materials derived primarily from sandstone and shale.	Avalon	60+	2-5	>6	7.9-8.4	2-8	B	3	.37	3	Moderate wind and water erosion hazard, topsoil is fair (excess salt), 8 inch precipitation zone. Shrink-swell potential is low, soil is slightly saline, high corrosion hazard to uncoated steel.

Table 2. CHARACTERISTICS OF THE SOILS IDENTIFIED ALONG MAIN WATER PIPELINE ROUTE P1 (continued)

Milepost	Map Symbol	Soil Phase, Series, Association,[1] or Complex and Description	Soil Phase or Series	Depth to Bedrock (inches)	Slope (%)	Depth to High Water Table (feet)	Soil Reaction (pH)	Salinity (mmhos/cm)	Hydrologic Group	WEG Class	'K'	'T'	Comments
13.15-13.20	Sd	Sheppard-Mayqueen-Shiprock: Deep, somewhat excessively and well drained, loamy fine sand, fine sand, and fine sandy loam soils formed on level to moderately sloping mesas and plateaus from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Sheppard Mayqueen Shiprock	60+ 60+ 60+	5-8 2-8 0-5	>6 >6 >6	7.9-8.4 7.9-8.4 7.4-8.4	<2 <2 <2	A B B	2 2 3	.15 .24 .24	5 5 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to good, 8 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.
13.20-13.25	Av	Avalon: Deep, well drained, sandy loam, and fine sandy loam soils formed on gently sloping mesas and plateaus from alluvial and eolian materials derived primarily from sandstone and shale.	Avalon	60+	2-5	>6	7.9-8.4	2-8	B	3	.37	3	Moderate wind and water erosion hazard, topsoil is fair (excess salt), 8 inch precipitation zone. Shrink-swell potential is low, soil is slightly saline, high corrosion hazard to uncoated steel.
13.25-13.6	Sm/Sd	Shiprock-Sheppard-Mayqueen: Deep, somewhat excessively and well drained, loamy fine sand, fine sand, fine sandy loam, and sandy loam soils formed on level to moderately sloping mesas and plateaus from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Shiprock Sheppard Mayqueen	60+ 60+ 60+	0-5 5-8 2-8	>6 >6 >6	7.4-8.4 7.9-8.4 7.9-8.4	<2 <2 <2	B A B	3 2 2	.24 .15 .24	5 5 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is good to poor, 8 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.
13.6-13.7	Da	Doak: Deep, well drained, loam, and clayey loam soils formed on level and nearly level mesas, plateaus, and terraces from alluvium derived primarily from sandstone and shale.	Doak	60+	0-1	>6	7.4-8.4	<2	B	5	.37	5	Low wind erosion hazard, moderate water erosion hazard, topsoil is fair (too clayey), 8 inch precipitation zone. Shrink-swell potential is low to moderate, low soil strength, high corrosion hazard to uncoated steel.
13.7-14.1	Sd/So	Sheppard-Mayqueen-Shiprock: Deep, somewhat excessively and well drained, loamy fine sand, fine sand, and fine sandy loam soils formed on level to moderately sloping mesas and plateaus from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Sheppard Mayqueen Shiprock	60+ 60+ 60+	5-8 2-8 0-5	>6 >6 >6	7.9-8.4 7.9-8.4 7.4-8.4	<2 <2 <2	A B B	2 2 3	.15 .24 .24	5 5 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to good, 8 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.
14.1-14.5	Db/Da	Doak: Deep, well drained, loam, and clay loam soils formed on level to gently sloping mesas, plateaus, and terraces from alluvium derived primarily from sandstone and shale.	Doak	60+	0-3	>6	7.4-8.4	<2	B	5	.37	5	Low wind erosion hazard, moderate water erosion hazard, topsoil is fair (too clayey), 8 inch precipitation zone. Shrink-swell potential is low to moderate, low soil strength, high corrosion hazard to uncoated steel.
14.5-14.8	Sd	Sheppard-Mayqueen-Shiprock: Deep, somewhat excessively and well drained, loamy fine sand, fine sand, and fine sandy loam soils formed on level to moderately sloping mesas and plateaus from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Sheppard Mayqueen Shiprock	60+ 60+ 60+	5-8 2-8 0-5	>6 >6 >6	7.9-8.4 7.9-8.4 7.4-8.4	<2 <2 <2	A B B	2 2 3	.15 .24 .24	5 5 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to good, 8 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.
14.8-15.25	Db	Doak: Deep, well drained, loam, and clay loam soils formed on level to gently sloping mesas, plateaus, and terraces from alluvium derived primarily from sandstone and shale.	Doak	60+	1-3	>6	7.4-8.4	<2	B	5	.37	5	Low wind erosion hazard, moderate water erosion hazard, topsoil is fair (too clayey), 8 inch precipitation zone. Shrink-swell potential is low to moderate, low soil strength, high corrosion hazard to uncoated steel.
15.25-15.45	Sd	Sheppard-Mayqueen-Shiprock: Deep, somewhat excessively and well drained, loamy fine sand, fine sand, and fine sandy loam soils formed on level to moderately sloping [illegible] and pl[illegible] from a[illegible] and	Sheppard Mayqueen Shiprock	60+ 60+ 60+	5-8 2-8 0-5	>6 >6 >6	7.9-8.4 7.9-8.4 7.4-8.4	<2 <2 <2	A B B	2 2 3	.15 .24 .24	5 5 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to good, 8 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to [illegible]ated [illegible]

Table 2. CHARACTERISTICS OF THE SOILS IDENTIFIED ALONG MAIN WATER PIPELINE ROUTE P1 (continued)

Milepost	Map Symbol	Soil Phase, Series, Association, or Complex and Description[1]	Soil Phase or Series	Depth to Bedrock (inches)	Slope (%)	Depth to High Water Table (feet)	Soil Reaction (pH)	Salinity (mmhos/cm)	Hydrologic Group	WEG Class	'K'	'T'	Comments
15.45-16.8	BA	Badland: Moderately sloping to extremely steep, nonstony, barren shale uplands that are dissected by deep intermittent drainageways and gullies.	Badland	0	5-80	NA	NA	NA	NA	NA	NA	NA	8 inch precipitation zone.
16.8-17.3	AZ	Avalon-Sheppard-Shiprock: Deep, well and somewhat excessively drained, sandy loam, loam, loamy fine sand, fine sand, and fine sandy loam soils formed on level to moderately sloping mesas and plateaus from alluvial and eolian materials derived primarily from sandstone and shale.	Avalon Sheppard Shiprock	60+ 60+ 60+	0-5 3-8 0-5	>6 >6 >6	7.9-8.4 7.9-8.4 7.4-8.4	2-8 <2 <2	B A B	3 2 3	.37 .15 .24	3 5 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is fair to good, 8 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.
17.3-19.2	HU	Huerfano-Muff-Uffens: Shallow to deep, well drained, sandy clay loam, clay loam, very fine sandy loam, and fine sandy loam soils formed on level to moderately sloping mesas and valleys from alluvium and residuum derived primarily from shale and siltstone.	Huerfano Muff Uffens	10-20 20-40 60+	0-3 0-8 0-5	>6 >6 >6	7.9-9.0 7.4-8.4 7.4-8.4	>4 2-4 4-8	D D D	4L 3 3	.32 .28 .20	1 3 1	Moderate wind and water erosion hazard, topsoil is poor due to shallowness and excess salt/sodium (Muff portion-area reclaim), 8 inch precipitation zone. Shrink-swell potential is low to moderate, exchangeable sodium content is 25-75%, high corrosion hazard to uncoated steel.
19.2-22.7	SC	Sheppard-Huerfano-Notal: Deep and shallow, somewhat excessively and well drained, loamy fine sand, fine sand, sandy clay loam, clay loam, and clay soils formed on level to moderately sloping valley bottoms, fans, mesas, and plateaus from eolian, alluvial, and residual materials derived from sandstone, shale, and siltstone.	Sheppard Huerfano Notal	60+ 10-20 60+	2-8 0-3 0-2	>6 >6 >6	7.9-8.4 7.9-9.0 7.9-9.0	<2 >4 4-8	A D D	2 4L 4L	.15 .32 .32	5 1 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is fair to poor, 8 inch precipitation zone. Shrink-swell potential is low to high, exchangeable sodium content ranges from 15-75% for Huerfano-Notal portion, high corrosion hazard to uncoated steel.
22.7-22.8	Du	Doak-Uffens: Deep, well drained, very fine sandy loam, sandy clay loam, fine sandy loam, and clay loam soils formed on level to gently sloping mesas and plateaus from alluvium derived primarily from sandstone and shale.	Doak Uffens	60+ 60+	0-3 0-3	>6 >6	7.4-8.4 7.4-8.4	<2 4-8	B D	3 3	.37 .20	5 1	Moderate wind and water erosion hazard, topsoil is fair to poor (excess clay or salt/sodium), 8 inch precipitation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
22.8-22.85	SC	Sheppard-Huerfano-Notal: Deep and shallow, somewhat excessively and well drained, loamy fine sand, fine sand, sandy clay loam, clay loam, and clay soils formed on level to moderately sloping valley bottoms, fans, mesas, and plateaus from eolian, alluvial, and residual materials derived from sandstone, shale, and siltstone.	Sheppard Huerfano Notal	60+ 10-20 60+	2-8 0-3 0-2	>6 >6 >6	7.9-8.4 7.9-9.0 7.9-9.0	<2 >4 4-8	A D D	2 4L 4L	.15 .32 .32	5 1 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is fair to poor, 8 inch precipitation zone. Shrink-swell potential is low to high, exchangeable sodium content ranges from 15-75% for Huerfano-Notal portion, high corrosion hazard to uncoated steel.
22.85-22.9	HU	Huerfano-Muff-Uffens: Shallow to deep, well drained, sandy clay loam, clay loam, very fine sandy loam, and fine sandy loam soils formed on level to moderately sloping mesas and valleys from alluvium and residuum derived primarily from shale and siltstone.	Huerfano Muff Uffens	10-20 20-40 60+	0-3 0-8 0-5	>6 >6 >6	7.9-9.0 7.4-8.4 7.4-8.4	>4 2-4 4-8	D D D	4L 3 3	.32 .28 .20	1 3 1	Moderate wind and water erosion hazard, topsoil is poor due to shallowness and excess salt/sodium (Muff portion-area reclaim), 8 inch precipitation zone. Shrink-swell potential is low to moderate, exchangeable sodium content is 25-75%, high corrosion hazard to uncoated steel.
22.9-22.95	Du	Doak-Uffens: Deep, well drained, very fine sandy loam, sandy clay loam, fine sandy loam, and clay loam soils formed on level to gently sloping mesas and plateaus from alluvium derived primarily from sandstone and shale.	Doak Uffens	60+ 60+	0-3 0-3	>6 >6	7.4-8.4 7.4-8.4	<2 4-8	B D	3 3	.37 .20	5 1	Moderate wind and water erosion hazard, topsoil is fair to poor (excess clay or salt/sodium), 8 inch precipitation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.

Table 2. CHARACTERISTICS OF THE SOILS IDENTIFIED ALONG MAIN WATER PIPELINE ROUTE P1 (continued)

Milepost	Map Symbol	Soil Phase, Series, Association, or Complex and Description[1]	Soil Phase or Series	Depth to Bedrock (inches)	Slope (%)	Depth to High Water Table (feet)	Soil Reaction (pH)	Salinity (mmhos/cm)	Hydrologic Group	WEG Class	'K'	'T'	Comments
22.95-23.0	Sd	Sheppard-Mayqueen-Shiprock: Deep, somewhat excessively and well drained, loamy fine sand, fine sand, and fine sandy loam soils formed on level to moderately sloping mesas and plateaus from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Sheppard Mayqueen Shiprock	60+ 60+ 60+	5-8 2-8 0-5	>6 >6 >6	7.9-8.4 7.9-8.4 7.4-8.4	<2 <2 <2	A B B	2 2 3	.15 .24 .24	5 5 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to good, 8 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.
23.0-23.3	Du	Doak-Uffens: Deep, well drained, very fine sandy loam, sandy clay loam, fine sandy loam, and clay loam soils formed on level to gently sloping mesas and plateaus from alluvium derived primarily from sandstone and shale.	Doak Uffens	60+ 60+	0-3 0-3	>6 >6	7.4-8.4 7.4-8.4	<2 4-8	B D	3 3	.37 .20	5 1	Moderate wind and water erosion hazard, topsoil is fair to poor (excess clay or salt/sodium), 8 inch precipitation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
23.3-23.4	SC	Sheppard-Huerfano-Notal: Deep and shallow, somewhat excessively and well drained, loamy fine sand, fine sand, sandy clay loam, clay loam, and clay soils formed on level to moderately sloping valley bottoms, fans, mesas, and plateaus from eolian, alluvial, and residual materials derived from sandstone, shale, and siltstone.	Sheppard Huerfano Notal	60+ 10-20 60+	2-8 0-3 0-2	>6 >6 >6	7.9-8.4 7.9-9.0 7.9-9.0	<2 >4 4-8	A D D	2 4L 4L	.15 .32 .32	5 1 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is fair to poor, 8 inch precipitation zone. Shrink-swell potential is low to high, exchangeable sodium content ranges from 15-75% for Huerfano-Notal portion, high corrosion hazard to uncoated steel.
23.4-23.5	HU	Huerfano-Muff-Uffens: Shallow to deep, well drained, sandy clay loam, clay loam, very fine sandy loam, and fine sandy loam soils formed on level to moderately sloping mesas and valleys from alluvium and residuum derived primarily from shale and siltstone.	Huerfano Muff Uffens	10-20 20-40 60+	0-3 0-8 0-5	>6 >6 >6	7.9-9.0 7.4-8.4 7.4-8.4	>4 2-4 4-8	D D D	4L 3 3	.32 .28 .20	1 3 1	Moderate wind and water erosion hazard, topsoil is poor due to shallowness and excess salt/sodium (Muff portion-area reclaim), 8 inch precipitation zone. Shrink-swell potential is low to moderate, exchangeable sodium content is 25-75%, high corrosion hazard to uncoated steel.
23.5-23.55	Sd	Sheppard-Mayqueen-Shiprock: Deep, somewhat excessively and well drained, loamy fine sand, fine sand, and fine sandy loam soils formed on level to moderately sloping mesas and plateaus from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Sheppard Mayqueen Shiprock	60+ 60+ 60+	5-8 2-8 0-5	>6 >6 >6	7.9-8.4 7.9-8.4 7.4-8.4	<2 <2 <2	A B B	2 2 3	.15 .24 .24	5 5 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to good, 8 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.
23.55-23.6	Du	Doak-Uffens: Deep, well drained, very fine sandy loam, sandy clay loam, fine sandy loam, and clay loam soils formed on level to gently sloping mesas and plateaus from alluvium derived primarily from sandstone and shale.	Doak Uffens	60+ 60+	0-3 0-3	>6 >6	7.4-8.4 7.4-8.4	<2 4-8	B D	3 3	.37 .20	5 1	Moderate wind and water erosion hazard, topsoil is fair to poor (excess clay or salt/sodium), 8 inch precipitation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
23.6-23.7	Av	Avalon: Deep, well drained, sandy loam, and fine sandy loam soils formed on gently sloping mesas and plateaus from alluvial and eolian materials derived primarily from sandstone and shale.	Avalon	60+	2-5	>6	7.9-8.4	2-8	B	3	.37	3	Moderate wind and water erosion hazard, topsoil is fair (excess salt), 8 inch precipitation zone. Shrink-swell potential is low, soil is slightly saline, high corrosion hazard to uncoated steel.
23.7-23.8	Sd	Sheppard-Mayqueen-Shiprock: Deep, somewhat excessively and well drained, loamy fine sand, fine sand, and fine sandy loam soils formed on level to moderately sloping mesas and plateaus from alluvial and [illegible] derived [illegible] sandsto[illegible]e, and [illegible] sources.	Sheppard Mayqueen Shiprock	60+ 60+ 60+	5-8 2-8 0-5	>6 >6 >6	7.9-8.4 7.9-8.4 7.4-8.4	<2 <2 <2	A B B	2 2 3	.15 .24 .24	5 5 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to good, 8 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to unco[illegible]el.

Table 2. CHARACTERISTICS OF THE SOILS IDENTIFIED ALONG MAIN WATER PIPELINE ROUTE P1 (continued)

Milepost	Map Symbol	Soil Phase, Series, Association, or Complex and Description[1]	Soil Phase or Series	Depth to Bedrock (inches)	Slope (%)	Depth to High Water Table (feet)	Soil Reaction (pH)	Salinity (mmhos/ cm)	Hydro-logic Group	WEG Class	'K'	'T'	Comments
23.8-23.85	Av	Avalon: Deep, well drained, sandy loam, and fine sandy loam soils formed on gently sloping mesas and plateaus from alluvial and eolian materials derived primarily from sandstone and shale.	Avalon	60+	2-5	>6	7.9-8.4	2-8	B	3	.37	3	Moderate wind and water erosion hazard, topsoil is fair (excess salt), 8 inch precipitation zone. Shrink-swell potential is low, soil is slightly saline, high corrosion hazard to uncoated steel.
23.85-23.95	Sd	Sheppard-Mayqueen-Shiprock: Deep, somewhat excessively and well drained, loamy fine sand, fine sand, and fine sandy loam soils formed on level to moderately sloping mesas and plateaus from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Sheppard Mayqueen Shiprock	60+ 60+ 60+	5-8 2-8 0-5	>6 >6 >6	7.9-8.4 7.9-8.4 7.4-8.4	<2 <2 <2	A B B	2 2 3	.15 .24 .24	5 5 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to good, 8 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.
23.95-24.0	Av	Avalon: Deep, well drained, sandy loam, and fine sandy loam soils formed on gently sloping mesas and plateaus from alluvial and eolian materials derived primarily from sandstone and shale.	Avalon	60+	2-5	>6	7.9-8.4	2-8	B	3	.37	3	Moderate wind and water erosion hazard, topsoil is fair (excess salt), 8 inch precipitation zone. Shrink-swell potential is low, soil is slightly saline, high corrosion hazard to uncoated steel.
24.0-24.9	Sd/So/ Sr	Sheppard-Shiprock-Mayqueen: Deep, somewhat excessively and well drained, loamy fine sand, fine sand, fine sandy loam, sandy loam, and sandy clay loam soils formed on level to moderately sloping mesas and plateaus from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Sheppard Shiprock Mayqueen	60+ 60+ 60+	5-8 0-5 2-8	>6 >6 >6	7.9-8.4 7.4-8.4 7.9-8.4	>2 >2 >2	A B B	2 3 2	.15 .24 .24	5 5 5	High and moderate wind erosion hazard, low to moderate water erosion hazard, poor to good topsoil, 8 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.
24.9-25.0	Av	Avalon: Deep, well drained, sandy loam, and fine sandy loam soils formed on gently sloping mesas and plateaus from alluvial and eolian materials derived primarily from sandstone and shale.	Avalon	60+	2-5	>6	7.9-8.4	2-8	B	3	.37	3	Moderate wind and water erosion hazard, topsoil is fair (excess salt), 8 inch precipitation zone. Shrink-swell potential is low, soil is slightly saline, high corrosion hazard to uncoated steel.
25.0-25.3	Sr	Shiprock (variant): Deep, well drained, sandy loam, fine sandy loam, and sandy clay loam soils formed on level to gently sloping mesas and plateaus from alluvial and eolian materials derived primarily from sandstone and shale.	Shiprock	60+	0-3	>6	7.9-8.4	<2	B	3	.24	5	Moderate wind and water erosion hazard, good topsoil, 8 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.
25.3-26.1	Sd	Sheppard-Mayqueen-Shiprock: Deep, somewhat excessively and well drained, loamy fine sand, fine sand, and fine sandy loam soils formed on level to moderately sloping mesas and plateaus from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Sheppard Mayqueen Shiprock	60+ 60+ 60+	5-8 2-8 0-5	>6 >6 >6	7.9-8.4 7.9-8.4 7.4-8.4	<2 <2 <2	A B B	2 2 3	.15 .24 .24	5 5 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to good, 8 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.
26.1-26.25	Du	Doak-Uffens: Deep, well drained, very fine sandy loam, sandy clay loam, fine sandy loam, and clay loam soils formed on level to gently sloping mesas and plateaus from alluvium derived primarily from sandstone and shale.	Doak Uffens	60+ 60+	0-3 0-3	>6 >6	7.4-8.4 7.4-8.4	<2 4-8	B D	3 3	.37 .20	5 1	Moderate wind and water erosion hazard, topsoil is fair to poor (excess clay or salt/sodium), 8 inch precipitation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.

Table 2. CHARACTERISTICS OF THE SOILS IDENTIFIED ALONG MAIN WATER PIPELINE ROUTE P1 (continued)

Milepost	Map Symbol	Soil Phase, Series, Association, or Complex and Description	Soil Phase or Series	Depth to Bedrock (inches)	Slope (%)	Depth to High Water Table (feet)	Soil Reaction (pH)	Salinity (mmhos/cm)	Hydrologic Group	WEG Class	'K'	'T'	Comments
26.25-28.4	Sd/So	Sheppard-Mayqueen-Shiprock: Deep, somewhat excessively and well drained, loamy fine sand, fine sand, and fine sandy loam soils formed on level to moderately sloping mesas and plateaus from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Sheppard Mayqueen Shiprock	60+ 60+ 60+	5-8 2-8 0-5	>6 >6 >6	7.9-8.4 7.9-8.4 7.4-8.4	<2 <2 <2	A B B	2 2 3	.15 .24 .24	5 5 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to good, 8 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.
28.4-28.85	SC	Sheppard-Huerfano-Notal: Deep and shallow, somewhat excessively and well drained, loamy fine sand, fine sand, sandy clay loam, clay loam, and clay soils formed on level to moderately sloping valley bottoms, fans, mesas, and plateaus from eolian, alluvial, and residual materials derived from sandstone, shale, and siltstone.	Sheppard Huerfano Notal	60+ 10-20 60+	2-8 0-3 0-2	>6 >6 >6	7.9-8.4 7.9-9.0 7.9-9.0	<2 >4 4-8	A D D	2 4L 4L	.15 .32 .32	5 1 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is fair to poor, 8 inch precipitation zone. Shrink-swell potential is low to high, exchangeable sodium content ranges from 15-75% for Huerfano-Notal portion, high corrosion hazard to uncoated steel.
28.85-29.15	Sd	Sheppard-Mayqueen-Shiprock: Deep, somewhat excessively and well drained, loamy fine sand, fine sand, and fine sandy loam soils formed on level to moderately sloping mesas and plateaus from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Sheppard Mayqueen Shiprock	60+ 60+ 60+	5-8 2-8 0-5	>6 >6 >6	7.9-8.4 7.9-8.4 7.4-8.4	<2 <2 <2	A B B	2 2 3	.15 .24 .24	5 5 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to good, 8 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.
29.15-29.35	SC	Sheppard-Huerfano-Notal: Deep and shallow, somewhat excessively and well drained, loamy fine sand, fine sand, sandy clay loam, clay loam, and clay soils formed on level to moderately sloping valley bottoms, fans, mesas, and plateaus from eolian, alluvial, and residual materials derived from sandstone, shale, and siltstone.	Sheppard Huerfano Notal	60+ 10-20 60+	2-8 0-3 0-2	>6 >6 >6	7.9-8.4 7.9-9.0 7.9-9.0	<2 >4 4-8	A D D	2 4L 4L	.15 .32 .32	5 1 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is fair to poor, 8 inch precipitation zone. Shrink-swell potential is low to high, exchangeable sodium content ranges from 15-75% for Huerfano-Notal portion, high corrosion hazard to uncoated steel.
29.35-29.6	Sd	Sheppard-Mayqueen-Shiprock: Deep, somewhat excessively and well drained, loamy fine sand, fine sand, and fine sandy loam soils formed on level to moderately sloping mesas and plateaus from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Sheppard Mayqueen Shiprock	60+ 60+ 60+	5-8 2-8 0-5	>6 >6 >6	7.9-8.4 7.9-8.4 7.4-8.4	<2 <2 <2	A B B	2 2 3	.15 .24 .24	5 5 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to good, 8 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.
29.6-30.8	SC	Sheppard-Huerfano-Notal: Deep and shallow, somewhat excessively and well drained, loamy fine sand, fine sand, sandy clay loam, clay loam, and clay soils formed on level to moderately sloping valley bottoms, fans, mesas, and plateaus from eolian, alluvial, and residual materials derived from sandstone, shale, and siltstone.	Sheppard Huerfano Notal	60+ 10-20 60+	2-8 0-3 0-2	>6 >6 >6	7.9-8.4 7.9-9.0 7.9-9.0	<2 >4 4-8	A D D	2 4L 4L	.15 .32 .32	5 1 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is fair to poor, 8 inch precipitation zone. Shrink-swell potential is low to high, exchangeable sodium content ranges from 15-75% for Huerfano-Notal portion, high corrosion hazard to uncoated steel.
30.8-33.3	BA	Badland: Moderately sloping to extremely steep, nonstony, barren shale uplands that are dissected by deep intermittent drainageways and gullies.	Badland	0	5-80	NA	NA	NA	NA	NA	NA	NA	8 inch precipitation zone.

Table 2. CHARACTERISTICS OF THE SOILS IDENTIFIED ALONG MAIN WATER PIPELINE ROUTE P1 (continued)

Milepost	Map Symbol	Soil Phase, Series, Association, or Complex and Description[1]	Soil Phase or Series	Depth to Bedrock (inches)	Slope (%)	Depth to High Water Table (feet)	Soil Reaction (pH)	Salinity (mmhos/cm)	Hydrologic Group	WEG Class	'K'	'T'	Comments
33.3-35.0	SC	Sheppard-Huerfano-Notal: Deep and shallow, somewhat excessively and well drained, loamy fine sand, fine sand, sandy clay loam, clay loam, and clay soils formed on level to moderately sloping valley bottoms, fans, mesas, and plateaus from eolian, alluvial, and residual materials derived from	Sheppard Huerfano Notal	60+ 10-20 60+	2-8 0-3 0-2	>6 >6 >6	7.9-8.4 7.9-9.0 7.9-9.0	<2 >4 4-8	A D D	2 4L 4L	.15 .32 .32	5 1 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is fair to poor, 8 inch precipitation zone. Shrink-swell potential is low to high, exchangeable sodium content ranges from 15-75% for Huerfano-Notal portion, high corrosion hazard to uncoated steel.
35.0-35.4	BA	Badland: Moderately sloping to extremely steep, nonstony, barren shale uplands that are dissected by deep intermittent drainageways and gullies.	Badland	0	5-80	NA	NA	NA	NA	NA	NA	NA	8 inch precipitation zone.
35.4-35.95	SC	Sheppard-Huerfano-Notal: Deep and shallow, somewhat excessively and well drained, loamy fine sand, fine sand, sandy clay loam, clay loam, and clay soils formed on level to moderately sloping valley bottoms, fans, mesas, and plateaus from eolian, alluvial, and residual materials derived from sandstone, shale, and siltstone.	Sheppard Huerfano Notal	60+ 10-20 60+	2-8 0-3 0-2	>6 >6 >6	7.9-8.4 7.9-9.0 7.9-9.0	<2 >4 4-8	A D D	2 4L 4L	.15 .32 .32	5 1 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is fair to poor, 8 inch precipitation zone. Shrink-swell potential is low to high, exchangeable sodium content ranges from 15-75% for Huerfano-Notal portion, high corrosion hazard to uncoated steel.
35.95-36.05	RD	Riverwash-Duneland: Deep, poorly to excessively drained, unstabilized sandy, silty, clayey, and gravelly alluvium occurring on level and nearly level floodplains, streambeds, and arroyos; and unstabilized eolian sand occurring on nearly level to steep mesas, plateaus, and major drainageways.	Riverwash Duneland	60+ 60+	0-2 2-40	0-2[2] >6	NA NA	NA NA	D A	NA 1	NA .15	NA 5	Low and high (Duneland portion) wind erosion hazard, high (Riverwash portion) and low water erosion hazard, poor topsoil, 6-10 inch precipitation zone. Riverwash portion is frequently flooded, and shrink-swell potential is low.
36.05-36.6	TAB	Turley-Fruitland-Blancot: Deep, well drained, clay loam, loam, fine sandy loam, and sandy loam soils formed on level to moderately steep alluvial fans, upland valley sideslopes, and mesas from mixed alluvium derived from sandstone and shale.	Turley Fruitland Blancot	60+ 60+ 60+	0-5 0-30 0-5	>6 >6 >6	7.4-9.0 7.4-8.4 7.9-9.0	2-4 <4 2-4	B B B	3,4L 1,3,5 3,5	.37 .28 .28	5 5 5	Low to high (Fruitland portion) wind erosion hazard, moderate water erosion hazard, fair to good topsoil, 6-10 inch precipitation zone. These soils are mildly to strongly alkaline (calcareous), and shrink-swell potential is low to moderate.
36.6-37.2	SSH	Shiprock-Sheppard-Huerfano: Deep to shallow, well to somewhat excessively drained, fine sandy loam, fine sand, loamy fine sand, sandy clay loam, sandy loam, and clay loam soils. These soils formed on nearly level to strongly sloping mesas, plateaus, and upland valley bottoms from sandy alluvial and eolian materials derived from sandstone; and from alluvium, residuum, and loess derived from shale and siltstone.	Shiprock Sheppard Huerfano	60+ 60+ 10-20	0-8 1-12 0-3	>6 >6 >6	7.4-9.0 7.4-8.4 7.9-9.0	<4 <2 >4	B A D	2,3 1 3,4L	.24 .10 .32	5 5 1	Moderate to high wind erosion hazard, moderate to low water erosion hazard, good to poor topsoil, 6-10 inch precipitation zone. These soils are mildly to strongly alkaline (Huerfano portion is sodium affected), and shrink-swell potential is low to moderate.
37.2-37.75	TAB	Turley-Fruitland-Blancot: Deep, well drained, clay loam, loam, fine sandy loam, and sandy loam soils formed on level to moderately steep alluvial fans, upland valley sideslopes, and mesas from mixed alluvium derived from sandstone and shale.	Turley Fruitland Blancot	60+ 60+ 60+	0-5 0-30 0-5	>6 >6 >6	7.4-9.0 7.4-8.4 7.9-9.0	2-4 <4 2-4	B B B	3,4L 1,3,5 3,5	.37 .28 .28	5 5 5	Low to high (Fruitland portion) wind erosion hazard, moderate water erosion hazard, fair to good topsoil, 6-10 inch precipitation zone. These soils are mildly to strongly alkaline (calcareous), and shrink-swell potential is low to moderate.

Table 2. CHARACTERISTICS OF THE SOILS IDENTIFIED ALONG MAIN WATER PIPELINE ROUTE P-1 (concluded)

Milepost	Map Symbol	Soil Phase, Series, Association, or Complex and Description[1]	Soil Phase or Series	Depth to Bedrock (inches)	Slope (%)	Depth to High Water Table (feet)	Soil Reaction (pH)	Salinity (mmhos/cm)	Hydrologic Group	WEG Class	'K'	'T'	Comments
37.75-37.95	BR	Badland-Rock Outcrop: Nonstony, moderately sloping to extremely steep barren shale uplands that are dissected by deep intermittent drainageways and gullies; and barren sandstone exposures on moderately sloping to extremely steep ridges, benches, and escarpments.	Badland Rock Outcrop	0 0	5-80 5-80	>6 >6	NA NA	NA NA	D D	NA NA	NA NA	NA NA	Wind erosion hazard is low, Badland portion is susceptible to water erosion, topsoil is generally nonexistent (i.e., poor topsoil), 6-10 inch precipitation zone. Potential runoff on Badland portion is very rapid.
37.95-38.3	TAB	Turley-Fruitland-Blancot: Deep, well drained, clay loam, loam, fine sandy loam, and sandy loam soils formed on level to moderately steep alluvial fans, upland valley sideslopes, and mesas from mixed alluvium derived from sandstone and shale.	Turley Fruitland Blancot	60+ 60+ 60+	0-5 0-30 0-5	>6 >6 >6	7.4-9.0 7.4-8.4 7.9-9.0	2-4 <4 2-4	B B B	3,4L 1,3,5 3,5	.37 .28 .28	5 5 5	Low to high (Fruitland portion) wind erosion hazard, moderate water erosion hazard, fair to good topsoil, 6-10 inch precipitation zone. These soils are mildly to strongly alkaline (calcareous), and shrink-swell potential is low to moderate.
38.3-38.4	SSH	Shiprock-Sheppard-Huerfano: Deep to shallow, well to somewhat excessively drained, fine sandy loam, fine sand, loamy fine sand, sandy clay loam, sandy loam, and clay loam soils. These soils formed on nearly level to strongly sloping mesas, plateaus, and upland valley bottoms from sandy alluvial and eolian materials derived from sandstone; and from alluvium, residuum, and loess derived from shale and siltstone.	Shiprock Sheppard Huerfano	60+ 60+ 10-20	0-8 1-12 0-3	>6 >6 >6	7.4-9.0 7.4-8.4 7.9-9.0	<4 <2 >4	B A D	2,3 1 3,4L	.24 .10 .32	5 5 1	Moderate to high wind erosion hazard, moderate to low water erosion hazard, good to poor topsoil, 6-10 inch precipitation zone. These soils are mildly to strongly alkaline (Huerfano portion is sodium affected), and shrink-swell potential is low to moderate.
38.4-39.2	SC	Sheppard-Huerfano-Notal: Deep and shallow, somewhat excessively and well drained, loamy fine sand, fine sand, sandy clay loam, clay loam, and clay soils formed on level to moderately sloping valley bottoms, fans, mesas, and plateaus from eolian, alluvial, and residual materials derived from sandstone, shale, and siltstone.	Sheppard Huerfano Notal	60+ 10-20 60+	2-8 0-3 0-2	>6 >6 >6	7.9-8.4 7.9-9.0 7.9-9.0	<2 >4 4-8	A D D	2 4L 4L	.15 .32 .32	5 1 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is fair to poor, 8 inch precipitation zone. Shrink-swell potential is low to high, exchangeable sodium content ranges from 15-75% for Huerfano-Notal portion, high corrosion hazard to uncoated steel.
39.2-39.55	BA	Badland: Moderately sloping to extremely steep, nonstony, barren shale uplands that are dissected by deep intermittent drainageways and gullies.	Badland	0	5-80	NA	NA	NA	NA	NA	NA	NA	8 inch precipitation zone.
39.55-39.7	SC	Sheppard-Huerfano-Notal: Deep and shallow, somewhat excessively and well drained, loamy fine sand, fine sand, sandy clay loam, clay loam, and clay soils formed on level to moderately sloping valley bottoms, fans, mesas, and plateaus from eolian, alluvial, and residual materials derived from sandstone, shale, and siltstone.	Sheppard Huerfano Notal	60+ 10-20 60+	2-8 0-3 0-2	>6 >6 >6	7.9-8.4 7.9-9.0 7.9-9.0	<2 >4 4-8	A D D	2 4L 4L	.15 .32 .32	5 1 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is fair to poor, 8 inch precipitation zone. Shrink-swell potential is low to high, exchangeable sodium content ranges from 15-75% for Huerfano-Notal portion, high corrosion hazard to uncoated steel.

NA = Not available or not applicable.

[1] Sources:
(1) U.S. Soil Conservation Service (SCS). 1980. Soil survey of San Juan County, New Mexico, eastern part. (For Mileposts 0.0-35.95 and 38.4-39.7).
(2) Buchanan, B. 1978. Soils field research, soils map. Prepared (under contract) for Public Service Company of New Mexico. Albuquerque, New Mexico. (And applicable SCS Form 5 - Soil Intrepretation Tables.) (For Mileposts 35.95-38.4.)

soil erosion is primarily low to moderate. The soils identified along the proposed P1 pipeline route are mildly to strongly alkaline. Shrink-swell potential of the identified soils is primarily low to moderate, but the Notal soil has a high shrink-swell potential. These soils are currently used primarily for livestock grazing, wildlife habitat, and to a lesser extent energy resource development. This pipeline route traverses the following undeveloped portions of NIIP: Block 6 (MP 4-7; 8-10); Block 7 (MP 7-8); Block 9 (MP 10-15); Block 11 (MP 23.5-25; 29-30.5); and Block 10 (MP 25-27.5). These areas have been determined to be irrigable.

Main Water Pipeline Alternative P2. Pipeline route P2 is within the San Juan River Valley Mesas and Plateaus portion of the Western Range and Irrigated Region (SCS 1978a). Annual precipitation along this route is usually about 8 inches. Thirty-one different soil phases, series, associations, or complexes were identified along this route. The identified soils are listed (by mileposts) and characterized in Table 3.

The soils identified along pipeline route P2 are primarily deep and well to somewhat excessively drained. Surface textures range from fine sand to clay. These soils are forming in alluvial, eolian, and residual materials derived primarily from sandstone, shale, and siltstone on mesas, plateaus, hills, canyons, valleys, and alluvial fans. The terrain slopes range mainly from nearly level to moderately sloping, but areas of moderately steep Badland would be traversed near Horn Canyon (MP 4.4-5.35) and southwest of Gallegos Canyon (between MP 14.6-15.0). Approximately 5.0 miles of Badland (nonstony, barren shale) and Badland-Rock Outcrop would be traversed by this pipeline route. Topsoil availability along this pipeline route is limited due to generally shallow soil surface layers, and the majority of the existing topsoil is of fair to poor quality due to undesirable surface

Table 3. CHARACTERISTICS OF THE SOILS IDENTIFIED ALONG MAIN WATER PIPELINE ROUTE P2

Milepost	Map Symbol	Soil Phase, Series, Association, or Complex and Description[1]	Soil Phase or Series	Depth to Bedrock (inches)	Slope (%)	Depth to High Water Table (feet)	Soil Reaction (pH)	Salinity (mmhos/cm)	Hydrologic Group	WEG Class	'K'	'T'	Comments
0.0-0.25	Fy	Fruitland-Slickspots: Deep, well and poorly drained, sandy loam soils formed on level to gently sloping fans and valleys from alluvium derived primarily from sandstone and shale. Includes Slickspots areas which are strongly alkali affected, and are easily puddled and crusted.	Fruitland	60+	0-3	>6	7.4-8.4	<4	B	3	.24	5	Moderate wind and water erosion hazard, topsoil is good (Slickspots areas are poor), 8 inch precipitation zone. Shrink-swell potential is low, Slickspots areas contain 15-50% exchangeable sodium (addition of gypsum reduces associated problems).
0.25-0.30	HA	Haplargids-Blackston-Torriorthents: Shallow to deep, well to excessively drained, cobbly sandy loam, cobbly sandy clay loam, gravelly loam, gravelly clay loam, cobbly loam, and clay loam soils formed on moderately sloping to steep terraces, mesas, and plateaus from alluvium derived from mixed sources.	Haplargids Blackston Torriorthents	10-60+ 60+ 10-20	8-50 8-40 8-50	NA >6 NA	NA 7.9-8.4 NA	NA 2-4 NA	NA B NA	NA 5 NA	NA .17 NA	NA 1 NA	Low wind erosion hazard, low to high water erosion hazard, poor topsoil (area reclaim), 9 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.
0.30-0.75	Ay/Ax	Avalon: Deep, well drained, loam, and sandy loam soils formed on level to moderately sloping mesas and plateaus from alluvial and eolian materials derived primarily from sandstone and shale.	Avalon	60+	0-8	>6	7.9-8.4	2-8	B	4L,3	.43, .37	3	Moderate wind erosion hazard, moderate to high water erosion hazard, fair topsoil (excess salt), 8 inch precipitation zone. Shrink-swell potential is low, soil is slightly saline, high corrosion hazard to uncoated steel.
0.75-0.95	FX	Fruitland-Persayo-Sheppard: Deep and shallow, well to somewhat excessively drained, sandy loam, fine sandy loam, clay loam, loamy fine sand, and fine sand soils formed on moderately sloping to moderately steep hills, mesas, plateaus, fans, and breaks from alluvium, residuum, and eolian materials derived from sandstone and shale.	Fruitland Persayo Sheppard	60+ 10-20 60+	5-30 5-30 5-30	>6 >6 >6	7.4-8.4 7.9-9.0 7.9-8.4	<4 <8 <2	B D A	3 4L 2	.24 .37 .15	5 1 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor (Persayo portion-area reclaim), 8 inch precipitation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
0.95-1.0	HA	Haplargids-Blackston-Torriorthents: Shallow to deep, well to excessively drained, cobbly sandy loam, cobbly sandy clay loam, gravelly loam, gravelly clay loam, cobbly loam, and clay loam soils formed on moderately sloping to steep terraces, mesas, and plateaus from alluvium derived from mixed sources.	Haplargids Blackston Torriorthents	10-60+ 60+ 10-20	8-50 8-40 8-50	NA >6 NA	NA 7.9-8.4 NA	NA 2-4 NA	NA B NA	NA 5 NA	NA .17 NA	NA 1 NA	Low wind erosion hazard, low to high water erosion hazard, poor topsoil (area reclaim), 9 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.
1.0-1.25	Av/Ax	Avalon: Deep, well drained, sandy loam, fine sandy loam, and loam soils formed on gently to moderately sloping mesas and plateaus from alluvial and eolian materials derived primarily from sandstone and shale.	Avalon	60+	2-8	>6	7.9-8.4	2-8	B	3	.37	3	Moderate wind and water erosion hazard, topsoil is fair (excess salt), 8 inch precipitation zone. Shrink-swell potential is low, soil is slightly saline, high corrosion hazard to uncoated steel.
1.25-1.60	BA	Badland: Moderately sloping to extremely steep, nonstony, barren shale uplands that are dissected by deep intermittent drainageways and gullies.	Badland	0	5-80	NA	NA	NA	NA	NA	NA	NA	8 inch precipitation zone.
1.60-1.85	GY	Gypsiorthids-Badland-Stumble: Very shallow to deep, well to excessively drained, sandy loam, loamy sand, and sand soils formed on moderately sloping to moderately steep hills, knolls, breaks, and valleys from materials derived from gypsum and from alluvium derived primarily from sandstone and shale. Includes nonstony, barren shale areas [illegible]ands th[illegible] dissec[illegible] deep	Gypsiorthids Badland Stumble	16 (ave.) 0 60+	5-30 5-30 5-8	>6 >6 >6	NA NA 7.9-8.4	NA NA <2	NA NA A	NA NA 2	NA NA .17	NA NA 5	High wind erosion hazard, low to moderate water erosion hazard, poor topsoil, 8 inch precipitation zone. Shrink-swell potential is low, Stumble portion presents high corrosion hazard to uncoated steel.

Table 3. CHARACTERISTICS OF THE SOILS IDENTIFIED ALONG MAIN WATER PIPELINE ROUTE P2 (continued)

Milepost	Map Symbol	Soil Phase, Series, Association, or Complex and Description[1]	Soil Phase or Series	Depth to Bedrock (inches)	Slope (%)	Depth to High Water Table (feet)	Soil Reaction (pH)	Salinity (mmhos/ cm)	Hydro-logic Group	WEG Class	'K'	'T'	Comments
1.85-2.0	Fv	Fruitland: Deep, well drained, loam, and sandy loam soils formed on moderately sloping alluvial fans and in valleys from alluvium derived primarily from sandstone and shale.	Fruitland	60+	5-8	>6	7.4-8.4	<4	B	5	.28	5	Low wind erosion hazard, moderate water erosion hazard, good topsoil, 8 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.
2.0-2.1	SZ	Stumble-Slickspots: Deep, somewhat excessively and poorly drained, loamy sand, and sand soils formed on level to gently sloping valley sides and fans from alluvium derived primarily from sandstone and shale. Includes Slickspots areas which are strongly alkali affected, and are easily puddled and crusted.	Stumble	60+	0-5	>6	7.9-8.4	<2	A	2	.17	5	High wind erosion hazard, low water erosion hazard, poor topsoil, 8 inch precipitation zone. Shrink-swell potential is low, Slickspots areas contain 25-75% exchangeable sodium, high corrosion hazard to uncoated steel.
2.1-2.25	RA	Riverwash: Deep, well to excessively drained, unstabilized sandy, silty, clayey, or gravelly sediment on level to gently sloping floodplains, streambeds, riverbeds, and in arroyos.	Riverwash	60+	0-3	NA	NA	NA	NA	NA	NA	NA	Highly susceptible to water erosion and reworking, frequently flooded, 8 inch precipitation zone.
2.25-2.30	Fv	Fruitland: Deep, well drained, loam, and sandy loam soils formed on moderately sloping alluvial fans and in valleys from alluvium derived primarily from sandstone and shale.	Fruitland	60+	5-8	>6	7.4-8.4	<4	B	5	.28	5	Low wind erosion hazard, moderate water erosion hazard, good topsoil, 8 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.
2.30-2.50	HA	Haplargids-Blackston-Torriorthents: Shallow to deep, well to excessively drained, cobbly sandy loam, cobbly sandy clay loam, gravelly loam, gravelly clay loam, cobbly loam, and clay loam soils formed on moderately sloping to steep terraces, mesas, and plateaus from alluvium derived from mixed sources.	Haplargids Blackston Torriorthents	10-60+ 60+ 10-20	8-50 8-40 8-50	NA >6 NA	NA 7.9-8.4 NA	NA 2-4 NA	NA B NA	NA 5 NA	NA .17 NA	NA 1 NA	Low wind erosion hazard, low to high water erosion hazard, poor topsoil (area reclaim), 9 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.
2.50-2.55	RA	Riverwash: Deep, well to excessively drained, unstabilized sandy, silty, clayey, or gravelly sediment on level to gently sloping floodplains, streambeds, riverbeds, and in arroyos.	Riverwash	60+	0-3	NA	NA	NA	NA	NA	NA	NA	Highly susceptible to water erosion and reworking, frequently flooded, 8 inch precipitation zone.
2.55-4.4	FX	Fruitland-Persayo-Sheppard: Deep and shallow, well to somewhat excessively drained, sandy loam, fine sandy loam, clay loam, loamy fine sand, and fine sand soils formed on moderately sloping to moderately steep hills, mesas, plateaus, fans, and breaks from alluvium, residuum, and eolian materials derived from sandstone and shale.	Fruitland Persayo Sheppard	60+ 10-20 60+	5-30 5-30 5-30	>6 >6 >6	7.4-8.4 7.9-9.0 7.9-8.4	<4 <8 <2	B D A	3 4L 2	.24 .37 .15	5 1 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor (Persayo portion-area reclaim), 8 inch precipitation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
4.4-4.7	BA	Badland: Moderately sloping to extremely steep, nonstony, barren shale uplands that are dissected by deep intermittent drainageways and gullies.	Badland	0	5-80	NA	NA	NA	NA	NA	NA	NA	8 inch precipitation zone.
4.7-4.75	RA	Riverwash: Deep, well to excessively drained, unstabilized sandy, silty, clayey, or gravelly sediment on level to gently sloping floodplains, streambeds, riverbeds, and in arroyos.	Riverwash	60+	0-3	NA	NA	NA	NA	NA	NA	NA	Highly susceptible to water erosion and reworking, frequently flooded, 8 inch precipitation zone.

Table 3. CHARACTERISTICS OF THE SOILS IDENTIFIED ALONG MAIN WATER PIPELINE ROUTE P2 (continued)

Milepost	Map Symbol	Soil Phase, Series, Association, or Complex and Description[1]	Soil Phase or Series	Depth to Bedrock (inches)	Slope (%)	Depth to High Water Table (feet)	Soil Reaction (pH)	Salinity (mmhos/cm)	Hydrologic Group	WEG Class	'K'	'T'	Comments
4.75-4.85	Fs	Fruitland: Deep, well drained, sandy loam soils formed on gently sloping alluvial fans and in valleys from alluvium derived primarily from sandstone and shale.	Fruitland	60+	2-5	>6	7.4-8.4	<4	B	3	.24	5	Moderate wind and water erosion hazard, good topsoil, 8 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.
4.85-5.35	BA	Badland: Moderately sloping to extremely steep, nonstony, barren shale uplands that are dissected by deep intermittent drainageways and gullies.	Badland	0	5-80	NA	NA	NA	NA	NA	NA	NA	8 inch precipitation zone.
5.35-5.65	FX	Fruitland-Persayo-Sheppard: Deep and shallow, well to somewhat excessively drained, sandy loam, fine sandy loam, clay loam, loamy fine sand, and fine sand soils formed on moderately sloping to moderately steep hills, mesas, plateaus, fans, and breaks from alluvium, residuum, and eolian materials derived from sandstone and shale.	Fruitland Persayo Sheppard	60+ 10-20 60+	5-30 5-30 5-30	>6 >6 >6	7.4-8.4 7.9-9.0 7.9-8.4	<4 <8 <2	B D A	3 4L 2	.24 .37 .15	5 1 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor (Persayo portion-area reclaim), 8 inch precipitation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
5.65-5.75	Sd	Sheppard-Mayqueen-Shiprock: Deep, somewhat excessively and well drained, loamy fine sand, fine sand, and fine sandy loam soils formed on level to moderately sloping mesas and plateaus from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Sheppard Mayqueen Shiprock	60+ 60+ 60+	5-8 2-8 0-5	>6 >6 >6	7.9-8.4 7.9-8.4 7.4-8.4	<2 <2 <2	A B B	2 2 3	.15 .24 .24	5 5 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to good, 8 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.
5.75-5.90	FX	Fruitland-Persayo-Sheppard: Deep and shallow, well to somewhat excessively drained, sandy loam, fine sandy loam, clay loam, loamy fine sand, and fine sand soils formed on moderately sloping to moderately steep hills, mesas, plateaus, fans, and breaks from alluvium, residuum, and eolian materials derived from sandstone and shale.	Fruitland Persayo Sheppard	60+ 10-20 60+	5-30 5-30 5-30	>6 >6 >6	7.4-8.4 7.9-9.0 7.9-8.4	<4 <8 <2	B D A	3 4L 2	.24 .37 .15	5 1 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor (Persayo portion-area reclaim), 8 inch precipitation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
5.9-6.9	So/Sp/Sd/Sm	Shiprock-Sheppard-Mayqueen: Deep, somewhat excessively and well drained, loamy fine sand, fine sand, fine sandy loam, and sandy loam soils formed on level to moderately sloping mesas and plateaus from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Shiprock Sheppard Mayqueen	60+ 60+ 60+	0-5 5-8 2-8	>6 >6 >6	7.4-8.4 7.9-8.4 7.9-8.4	<2 <2 <2	B A B	3 2 2	.24 .15 .24	5 5 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is good to poor, 8 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.
6.9-7.0	Db	Doak: Deep, well drained, loam, and clay loam soils formed on level to gently sloping mesas, plateaus, and terraces from alluvium derived primarily from sandstone and shale.	Doak	60+	1-3	>6	7.4-8.4	<2	B	5	.37	5	Low wind erosion hazard, moderate water erosion hazard, topsoil is fair (too clayey), 8 inch precipitation zone. Shrink-swell potential is low to moderate, low soil strength, high corrosion hazard to uncoated steel.
7.0-7.45	Sd/So/Sm	Shiprock-Sheppard-Mayqueen: Deep, somewhat excessively and well drained, loamy fine sand, fine sand, fine sandy loam, and sandy loam soils formed on level to moderately sloping mesas and plateaus from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Shiprock Sheppard Mayqueen	60+ 60+ 60+	0-5 5-8 2-8	>6 >6 >6	7.4-8.4 7.9-8.4 7.9-8.4	<2 <2 <2	B A B	3 2 2	.24 .15 .24	5 5 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is good to poor, 8 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.
7.45-7.75	Av	Avalon: Deep, well drained, sandy loam, and fine sandy loam soils formed on gently sloping mesas and plateaus from alluvial and eolian materials derived primarily from sa[illegible]tone and shale.	Avalon	60+	2-5	>6	7.9-8.4	2-8	B	3	.37	3	Moderate wind and water erosion hazard, topsoil is fair (excess salt), 8 inch precipitation zone. Shrink-swell potential is low, soil is slightly saline, high corrosion [illegible] to unc[illegible]teel.

Table 3. CHARACTERISTICS OF THE SOILS IDENTIFIED ALONG MAIN WATER PIPELINE ROUTE P2 (continued)

Milepost	Map Symbol	Soil Phase, Series, Association, or Complex and Description[1]	Soil Phase or Series	Depth to Bedrock (inches)	Slope (%)	Depth to High Water Table (feet)	Soil Reaction (pH)	Salinity (mmhos/cm)	Hydrologic Group	WEG Class	'K'	'T'	Comments
7.75–8.8	Sd/So/Sm	Shiprock-Sheppard-Mayqueen: Deep, somewhat excessively and well drained, loamy fine sand, fine sand, fine sandy loam, and sandy loam soils formed on level to moderately sloping mesas and plateaus from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Shiprock Sheppard Mayqueen	60+ 60+ 60+	0–5 5–8 2–8	>6 >6 >6	7.4–8.4 7.9–8.4 7.9–8.4	<2 <2 <2	B A B	3 2 2	.24 .15 .24	5 5 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is good to poor, 8 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.
8.8–9.1	Da	Doak: Deep, well drained, loam, and clayey loam soils formed on level and nearly level mesas, plateaus, and terraces from alluvium derived primarily from sandstone and shale.	Doak	60+	0–1	>6	7.4–8.4	<2	B	5	.37	5	Low wind erosion hazard, moderate water erosion hazard, topsoil is fair (too clayey), 8 inch precipitation zone. Shrink-swell potential is low to moderate, low soil strength, high corrosion hazard to uncoated steel.
9.1–9.95	Sd/So/Sm	Shiprock-Sheppard-Mayqueen: Deep, somewhat excessively and well drained, loamy fine sand, fine sand, fine sandy loam, and sandy loam soils formed on level to moderately sloping mesas and plateaus from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Shiprock Sheppard Mayqueen	60+ 60+ 60+	0–5 5–8 2–8	>6 >6 >6	7.4–8.4 7.9–8.4 7.9–8.4	<2 <2 <2	B A B	3 2 2	.24 .15 .24	5 5 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is good to poor, 8 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.
9.95–10.1	Ma	Mayqueen: Deep, somewhat excessively drained, loamy fine sand, and loamy sand soils formed on level to moderately sloping mesas and plateaus from alluvial and eolian materials derived primarily from sandstone and shale.	Mayqueen	60+	0–8	>6	7.9–8.4	<2	B	2	.24	5	High wind erosion hazard, moderate water erosion hazard, poor topsoil, 8 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.
10.1–13.3	Sm/Sd/So	Shiprock-Sheppard-Mayqueen: Deep, somewhat excessively and well drained, loamy fine sand, fine sand, fine sandy loam, and sandy loam soils formed on level to moderately sloping mesas and plateaus from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Shiprock Sheppard Mayqueen	60+ 60+ 60+	0–5 5–8 2–8	>6 >6 >6	7.4–8.4 7.9–8.4 7.9–8.4	<2 <2 <2	B A B	3 2 2	.24 .15 .24	5 5 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is good to poor, 8 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.
13.3–13.45	Dc	Doak: Deep, well drained, loam, and clay loam soils formed on gently sloping mesas, plateaus, and terraces from alluvium derived primarily from sandstone and shale.	Doak	60+	3–5	>6	7.4–8.4	<2	B	5	.37	5	Low wind erosion hazard, moderate water erosion hazard, fair topsoil, 8 inch precipitation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
13.45–13.55	SZ	Stumble-Slickspots: Deep, somewhat excessively and poorly drained, loamy sand, and sand soils formed on level to gently sloping valley sides and fans from alluvium derived primarily from sandstone and shale. Includes Slickspots areas which are strongly alkali affected, and are easily puddled and crusted.	Stumble	60+	0–5	>6	7.9–8.4	<2	A	2	.17	5	High wind erosion hazard, low water erosion hazard, poor topsoil, 8 inch precipitation zone. Shrink-swell potential is low, Slickspots areas contain 25–75% exchangeable sodium, high corrosion hazard to uncoated steel.
13.55–13.60	RA	Riverwash: Deep, well to excessively drained, unstabilized sandy, silty, clayey, or gravelly sediment on level to gently sloping floodplains, streambeds, riverbeds, and in arroyos.	Riverwash	60+	0–3	NA	NA	NA	NA	NA	NA	NA	Highly susceptible to water erosion and reworking, frequently flooded, 8 inch precipitation zone.
13.6–13.8	Sd	Sheppard-Mayqueen-Shiprock: Deep, somewhat excessively and well drained, loamy fine sand, fine sand, and fine sandy loam soils formed on level to moderately sloping mesas and plateaus from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Sheppard Mayqueen Shiprock	60+ 60+ 60+	5–8 2–8 0–5	>6 >6 >6	7.9–8.4 7.9–8.4 7.4–8.4	<2 <2 <2	A B B	2 2 3	.15 .24 .24	5 5 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to good, 8 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.

Table 3. CHARACTERISTICS OF THE SOILS IDENTIFIED ALONG MAIN WATER PIPELINE ROUTE P2 (continued)

Milepost	Map Symbol	Soil Phase, Series, Association, or Complex and Description[1]	Soil Phase or Series	Depth to Bedrock (inches)	Slope (%)	Depth to High Water Table (feet)	Soil Reaction (pH)	Salinity (mmhos/cm)	Hydrologic Group	WEG Class	'K'	'T'	Comments
13.8-14.0	SB	Sheppard-Badland: Deep, somewhat excessively drained, loamy fine sand, and fine sand soils formed on moderately sloping to steep mesas, plateaus, and breaks from eolian materials derived from mixed sources. Includes nonstony, barren shale areas on uplands that are dissected by drainageways and gullies.	Sheppard Badland	60+ 0	5-40 5-40	>6 >6	7.9-8.4 NA	<2 NA	A NA	2 NA	.15 NA	5 NA	High wind erosion hazard, low water erosion hazard, poor topsoil, 8 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.
14.0-14.15	RA	Riverwash: Deep, well to excessively drained, unstabilized sandy, silty, clayey, or gravelly sediment on level to gently sloping floodplains, streambeds, riverbeds, and in arroyos.	Riverwash	60+	0-3	NA	NA	NA	NA	NA	NA	NA	Highly susceptible to water erosion and reworking, frequently flooded, 8 inch precipitation zone.
14.15-14.25	FX	Fruitland-Persayo-Sheppard: Deep and shallow, well to somewhat excessively drained, sandy loam, fine sandy loam, clay loam, loamy fine sand, and fine sand soils formed on moderately sloping to moderately steep hills, mesas, plateaus, fans, and breaks from alluvium, residuum, and eolian materials derived from sandstone and shale.	Fruitland Persayo Sheppard	60+ 10-20 60+	5-30 5-30 5-30	>6 >6 >6	7.4-8.4 7.9-9.0 7.9-8.4	<4 <8 <2	B D A	3 4L 2	.24 .37 .15	5 1 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor (Persayo portion-area reclaim), 8 inch precipitation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
14.25-14.5	Tv	Turley-Slickspots: Deep, well drained, clay loam soils formed on level to gently sloping alluvial fans from alluvium derived from primarily from sandstone and shale. Includes Slickspots areas which are strongly alkali affected, and are slowly permeable and easily puddled.	Turley	60+	0-3	>6	7.4-9.0	2-4	B	4L	.28	5	Moderate wind and water erosion hazard, fair topsoil (Slickspots areas are poor), 8 inch precipitation zone. Shrink-swell potential is moderate, Slickspots contain 25-75% exchangeable sodium, high corrosion hazard to uncoated steel.
14.5-14.6	FX	Fruitland-Persayo-Sheppard: Deep and shallow, well to somewhat excessively drained, sandy loam, fine sandy loam, clay loam, loamy fine sand, and fine sand soils formed on moderately sloping to moderately steep hills, mesas, plateaus, fans, and breaks from alluvium, residuum, and eolian materials derived from sandstone and shale.	Fruitland Persayo Sheppard	60+ 10-20 60+	5-30 5-30 5-30	>6 >6 >6	7.4-8.4 7.9-9.0 7.9-8.4	<4 <8 <2	B D A	3 4L 2	.24 .37 .15	5 1 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor (Persayo portion-area reclaim), 8 inch precipitation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
14.6-15.0	BA	Badland: Moderately sloping to extremely steep, nonstony, barren shale uplands that are dissected by deep intermittent drainageways and gullies.	Badland	0	5-80	NA	NA	NA	NA	NA	NA	NA	8 inch precipitation zone.
15.0-15.4	Du	Doak-Uffens: Deep, well drained, very fine sandy loam, sandy clay loam, fine sandy loam, and clay loam soils formed on level to gently sloping mesas and plateaus from alluvium derived primarily from sandstone and shale.	Doak Uffens	60+ 60+	0-3 0-3	>6 >6	7.4-8.4 7.4-8.4	<2 4-8	B D	3 3	.37 .20	5 1	Moderate wind and water erosion hazard, topsoil is fair to poor (excess clay or salt/sodium), 8 inch precipitation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
15.4-15.6	Sd	Sheppard-Mayqueen-Shiprock: Deep, somewhat excessively and well drained, loamy fine sand, fine sand, and fine sandy loam soils formed on level to moderately sloping mesas and plateaus from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Sheppard Mayqueen Shiprock	60+ 60+ 60+	5-8 2-8 0-5	>6 >6 >6	7.9-8.4 7.9-8.4 7.4-8.4	<2 <2 <2	A B B	2 2 3	.15 .24 .24	5 5 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to good, 8 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.

Table 3. CHARACTERISTICS OF THE SOILS IDENTIFIED ALONG MAIN WATER PIPELINE ROUTE P2 (continued)

Milepost	Map Symbol	Soil Phase, Series, Association,[1] or Complex and Description	Soil Phase or Series	Depth to Bedrock (inches)	Slope (%)	Depth to High Water Table (feet)	Soil Reaction (pH)	Salinity (mmhos/cm)	Hydrologic Group	WEG Class	'K'	'T'	Comments
15.6-15.7	Du	Doak-Uffens: Deep, well drained, very fine sandy loam, sandy clay loam, fine sandy loam, and clay loam soils formed on level to gently sloping mesas and plateaus from alluvium derived primarily from sandstone and shale.	Doak Uffens	60+ 60+	0-3 0-3	>6 >6	7.4-8.4 7.4-8.4	<2 4-8	B D	3 3	.37 .20	5 1	Moderate wind and water erosion hazard, topsoil is fair to poor (excess clay or salt/sodium), 8 inch precipitation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
15.7-15.75	Sd	Sheppard-Mayqueen-Shiprock: Deep, somewhat excessively and well drained, loamy fine sand, fine sand, and fine sandy loam soils formed on level to moderately sloping mesas and plateaus from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Sheppard Mayqueen Shiprock	60+ 60+ 60+	5-8 2-8 0-5	>6 >6 >6	7.9-8.4 7.9-8.4 7.4-8.4	<2 <2 <2	A B B	2 2 3	.15 .24 .24	5 5 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to good, 8 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.
15.75-15.8	Du	Doak-Uffens: Deep, well drained, very fine sandy loam, sandy clay loam, fine sandy loam, and clay loam soils formed on level to gently sloping mesas and plateaus from alluvium derived primarily from sandstone and shale.	Doak Uffens	60+ 60+	0-3 0-3	>6 >6	7.4-8.4 7.4-8.4	<2 4-8	B D	3 3	.37 .20	5 1	Moderate wind and water erosion hazard, topsoil is fair to poor (excess clay or salt/sodium), 8 inch precipitation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
15.8-16.0	Sd	Sheppard-Mayqueen-Shiprock: Deep, somewhat excessively and well drained, loamy fine sand, fine sand, and fine sandy loam soils formed on level to moderately sloping mesas and plateaus from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Sheppard Mayqueen Shiprock	60+ 60+ 60+	5-8 2-8 0-5	>6 >6 >6	7.9-8.4 7.9-8.4 7.4-8.4	<2 <2 <2	A B B	2 2 3	.15 .24 .24	5 5 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to good, 8 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.
16.0-16.05	Du	Doak-Uffens: Deep, well drained, very fine sandy loam, sandy clay loam, fine sandy loam, and clay loam soils formed on level to gently sloping mesas and plateaus from alluvium derived primarily from sandstone and shale.	Doak Uffens	60+ 60+	0-3 0-3	>6 >6	7.4-8.4 7.4-8.4	<2 4-8	B D	3 3	.37 .20	5 1	Moderate wind and water erosion hazard, topsoil is fair to poor (excess clay or salt/sodium), 8 inch precipitation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
16.05-16.55	Sd	Sheppard-Mayqueen-Shiprock: Deep, somewhat excessively and well drained, loamy fine sand, fine sand, and fine sandy loam soils formed on level to moderately sloping mesas and plateaus from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Sheppard Mayqueen Shiprock	60+ 60+ 60+	5-8 2-8 0-5	>6 >6 >6	7.9-8.4 7.9-8.4 7.4-8.4	<2 <2 <2	A B B	2 2 3	.15 .24 .24	5 5 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to good, 8 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.
16.55-17.0	Du	Doak-Uffens: Deep, well drained, very fine sandy loam, sandy clay loam, fine sandy loam, and clay loam soils formed on level to gently sloping mesas and plateaus from alluvium derived primarily from sandstone and shale.	Doak Uffens	60+ 60+	0-3 0-3	>6 >6	7.4-8.4 7.4-8.4	<2 4-8	B D	3 3	.37 .20	5 1	Moderate wind and water erosion hazard, topsoil is fair to poor (excess clay or salt/sodium), 8 inch precipitation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
17.0-17.4	Sm	Shiprock: Deep, well drained, fine sandy loam, and sandy loam soils formed on level and nearly level mesas and plateaus from alluvial and eolian materials derived primarily from sandstone and shale.	Shiprock	60+	0-2	>6	7.4-8.4	<2	B	3	.24	5	Moderate wind and water erosion hazard, good topsoil, 8 inch precipitation zone. Shrink-swell potential is low, highly corrosive to uncoated steel.
17.4-17.55	Du	Doak-Uffens: Deep, well drained, very fine sandy loam, sandy clay loam, fine sandy loam, and clay loam soils formed on level to gently sloping mesas and plateaus from alluvium derived primarily from sandstone and shale.	Doak Uffens	60+ 60+	0-3 0-3	>6 >6	7.4-8.4 7.4-8.4	<2 4-8	B D	3 3	.37 .20	5 1	Moderate wind and water erosion hazard, topsoil is fair to poor (excess clay or salt/sodium), 8 inch precipitation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.

Table 3. CHARACTERISTICS OF THE SOILS IDENTIFIED ALONG MAIN WATER PIPELINE ROUTE P2 (continued)

Milepost	Map Symbol	Soil Phase, Series, Association, or Complex and Description[1]	Soil Phase or Series	Depth to Bedrock (inches)	Slope (%)	Depth to High Water Table (feet)	Soil Reaction (pH)	Salinity (mmhos/cm)	Hydrologic Group	WEG Class	'K'	'T'	Comments
17.55-18.05	Sm/Sd	Shiprock-Sheppard-Mayqueen: Deep, somewhat excessively and well drained, loamy fine sand, fine sand, fine sandy loam, and sandy loam soils formed on level to moderately sloping mesas and plateaus from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Shiprock Sheppard Mayqueen	60+ 60+ 60+	0-5 5-8 2-8	>6 >6 >6	7.4-8.4 7.9-8.4 7.9-8.4	<2 <2 <2	B A B	3 2 2	.24 .15 .24	5 5 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is good to poor, 8 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.
18.05-18.1	FX	Fruitland-Persayo-Sheppard: Deep and shallow, well to somewhat excessively drained, sandy loam, fine sandy loam, clay loam, loamy fine sand, and fine sand soils formed on moderately sloping to moderately steep hills, mesas, plateaus, fans, and breaks from alluvium, residuum, and eolian materials derived from sandstone and shale.	Fruitland Persayo Sheppard	60+ 10-20 60+	5-30 5-30 5-30	>6 >6 >6	7.4-8.4 7.9-9.0 7.9-8.4	<4 <8 <2	B D A	3 4L 2	.24 .37 .15	5 1 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor (Persayo portion-area reclaim), 8 inch precipitation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
18.1-18.2	BB	Badland-Monierco-Rock Outcrop: Shallow, well drained, fine sandy loam, clay loam, and sandy clay loam soils formed on level to moderately sloping hills, ridges, and mesas from alluvial and eolian materials derived primarily from shale. Includes nonstony, barren shale areas on uplands that are dissected by deep intermittent drainageways and gullies, and barren sandstone outcrops on moderately sloping to steep ridges, benches, and escarpments.	Badland Monierco Rock Outcrop	0 10-20 0	5-30 0-8 5-30	>6 >6 >6	NA 7.4-8.4 NA	NA <2 NA	NA D NA	NA 3 NA	NA .24 NA	NA 1 NA	Wind and water erosion hazard is moderate, poor topsoil, 8 inch precipitation zone. Shrink-swell potential is low to moderate, moderate corrosion hazard to uncoated steel.
18.2-18.3	RA	Riverwash: Deep, well to excessively drained, unstabilized sandy, silty, clayey, or gravelly sediment on level to gently sloping floodplains, streambeds, riverbeds, and in arroyos.	Riverwash	60+	0-3	NA	NA	NA	NA	NA	NA	NA	Highly susceptible to water erosion and reworking, frequently flooded, 8 inch precipitation zone.
18.3-18.45	FX	Fruitland-Persayo-Sheppard: Deep and shallow, well to somewhat excessively drained, sandy loam, fine sandy loam, clay loam, loamy fine sand, and fine sand soils formed on moderately sloping to moderately steep hills, mesas, plateaus, fans, and breaks from alluvium, residuum, and eolian materials derived from sandstone and shale.	Fruitland Persayo Sheppard	60+ 10-20 60+	5-30 5-30 5-30	>6 >6 >6	7.4-8.4 7.9-9.0 7.9-8.4	<4 <8 <2	B D A	3 4L 2	.24 .37 .15	5 1 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor (Persayo portion-area reclaim), 8 inch precipitation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
18.45-18.65	Da	Doak: Deep, well drained, loam, and clayey loam soils formed on level and nearly level mesas, plateaus, and terraces from alluvium derived primarily from sandstone and shale.	Doak	60+	0-1	>6	7.4-8.4	<2	B	5	.37	5	Low wind erosion hazard, moderate water erosion hazard, topsoil is fair (too clayey), 8 inch precipitation zone. Shrink-swell potential is low to moderate, low soil strength, high corrosion hazard to uncoated steel.
18.65-18.7	So	Shiprock: Deep, well drained, fine sandy loam, and sandy loam soils formed on gently sloping mesas and plateaus from alluvial and eolian materials derived primarily from sandstone and shale.	Shiprock	60+	2-5	>6	7.4-8.4	<2	B	3	.24	5	Moderate wind and water erosion hazard, good topsoil, 8 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.
18.7-18.9	HU	Huerfano-Muff-Uffens: Shallow to deep, well drained, sandy clay loam, clay loam, very fine sandy loam, and fine sandy loam soils formed on level to moderately sloping mesas and valleys from alluvium and residuum derived primarily from shale and [illegible]stone	Huerfano Muff Uffens	10-20 20-40 60+	0-3 0-8 0-5	>6 >6 >6	7.9-9.0 7.4-8.4 7.4-8.4	>4 2-4 4-8	D D D	4L 3 3	.32 .28 .20	1 3 1	Moderate wind and water erosion hazard, topsoil is poor due to shallowness and excess salt/sodium (Muff portion-area reclaim), 8 inch precipitation zone. Shrink-swell potential is low to moderate, exchangeable sod[illegible]tent i[illegible], high[illegible]

Table 3. CHARACTERISTICS OF THE SOILS IDENTIFIED ALONG MAIN WATER PIPELINE ROUTE P2 (continued)

Milepost	Map Symbol	Soil Phase, Series, Association,[1] or Complex and Description	Soil Phase or Series	Depth to Bedrock (inches)	Slope (%)	Depth to High Water Table (feet)	Soil Reaction (pH)	Salinity (mmhos/ cm)	Hydro-logic Group	WEG Class	'K'	'T'	Comments
18.9-19.0	So	Shiprock: Deep, well drained, fine sandy loam, and sandy loam soils formed on gently sloping mesas and plateaus from alluvial and eolian materials derived primarily from sandstone and shale.	Shiprock	60+	2-5	>6	7.4-8.4	<2	B	3	.24	5	Moderate wind and water erosion hazard, good topsoil, 8 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.
19.0-19.2	HU	Huerfano-Muff-Uffens: Shallow to deep, well drained, sandy clay loam, clay loam, very fine sandy loam, and fine sandy loam soils formed on level to moderately sloping mesas and valleys from alluvium and residuum derived primarily from shale and siltstone.	Huerfano Muff Uffens	10-20 20-40 60+	0-3 0-8 0-5	>6 >6 >6	7.9-9.0 7.4-8.4 7.4-8.4	>4 2-4 4-8	D D D	4L 3 3	.32 .28 .20	1 3 1	Moderate wind and water erosion hazard, topsoil is poor due to shallowness and excess salt/sodium (Muff portion-area reclaim), 8 inch precipitation zone. Shrink-swell potential is low to moderate, exchangeable sodium content is 25-75%, high corrosion hazard to uncoated steel.
19.2-19.3	Sd	Sheppard-Mayqueen-Shiprock: Deep, somewhat excessively and well drained, loamy fine sand, fine sand, and fine sandy loam soils formed on level to moderately sloping mesas and plateaus from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Sheppard Mayqueen Shiprock	60+ 60+ 60+	5-8 2-8 0-5	>6 >6 >6	7.9-8.4 7.9-8.4 7.4-8.4	<2 <2 <2	A B B	2 2 3	.15 .24 .24	5 5 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to good, 8 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.
19.3-19.7	HU	Huerfano-Muff-Uffens: Shallow to deep, well drained, sandy clay loam, clay loam, very fine sandy loam, and fine sandy loam soils formed on level to moderately sloping mesas and valleys from alluvium and residuum derived primarily from shale and siltstone.	Huerfano Muff Uffens	10-20 20-40 60+	0-3 0-8 0-5	>6 >6 >6	7.9-9.0 7.4-8.4 7.4-8.4	>4 2-4 4-8	D D D	4L 3 3	.32 .28 .20	1 3 1	Moderate wind and water erosion hazard, topsoil is poor due to shallowness and excess salt/sodium (Muff portion-area reclaim), 8 inch precipitation zone. Shrink-swell potential is low to moderate, exchangeable sodium content is 25-75%, high corrosion hazard to uncoated steel.
19.7-19.9	So	Shiprock: Deep, well drained, fine sandy loam, and sandy loam soils formed on gently sloping mesas and plateaus from alluvial and eolian materials derived primarily from sandstone and shale.	Shiprock	60+	2-5	>6	7.4-8.4	<2	B	3	.24	5	Moderate wind and water erosion hazard, good topsoil, 8 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.
19.9-20.55	Sd	Sheppard-Mayqueen-Shiprock: Deep, somewhat excessively and well drained, loamy fine sand, fine sand, and fine sandy loam soils formed on level to moderately sloping mesas and plateaus from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Sheppard Mayqueen Shiprock	60+ 60+ 60+	5-8 2-8 0-5	>6 >6 >6	7.9-8.4 7.9-8.4 7.4-8.4	<2 <2 <2	A B B	2 2 3	.15 .24 .24	5 5 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to good, 8 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.
20.55-20.6	Da	Doak: Deep, well drained, loam, and clayey loam soils formed on level and nearly level mesas, plateaus, and terraces from alluvium derived primarily from sandstone and shale.	Doak	60+	0-1	>6	7.4-8.4	<2	B	5	.37	5	Low wind erosion hazard, moderate water erosion hazard, topsoil is fair (too clayey), 8 inch precipitation zone. Shrink-swell potential is low to moderate, low soil strength, high corrosion hazard to uncoated steel.
20.6-20.7	Sd	Sheppard-Mayqueen-Shiprock: Deep, somewhat excessively and well drained, loamy fine sand, fine sand, and fine sandy loam soils formed on level to moderately sloping mesas and plateaus from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Sheppard Mayqueen Shiprock	60+ 60+ 60+	5-8 2-8 0-5	>6 >6 >6	7.9-8.4 7.9-8.4 7.4-8.4	<2 <2 <2	A B B	2 2 3	.15 .24 .24	5 5 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to good, 8 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.

Table 3. CHARACTERISTICS OF THE SOILS IDENTIFIED ALONG MAIN WATER PIPELINE ROUTE P2 (continued)

Milepost	Map Symbol	Soil Phase, Series, Association, or Complex and Description[1]	Soil Phase or Series	Depth to Bedrock (inches)	Slope (%)	Depth to High Water Table (feet)	Soil Reaction (pH)	Salinity (mmhos/cm)	Hydrologic Group	WEG Class	'K'	'T'	Comments
20.7-20.75	Da	Doak: Deep, well drained, loam, and clayey loam soils formed on level and nearly level mesas, plateaus, and terraces from alluvium derived primarily from sandstone and shale.	Doak	60+	0-1	>6	7.4-8.4	<2	B	5	.37	5	Low wind erosion hazard, moderate water erosion hazard, topsoil is fair (too clayey), 8 inch precipitation zone. Shrink-swell potential is low to moderate, low soil strength, high corrosion hazard to uncoated steel.
20.75-26.0	Sd/So/Sm	Shiprock-Sheppard-Mayqueen: Deep, somewhat excessively and well drained, loamy fine sand, fine sand, fine sandy loam, and sandy loam soils formed on level to moderately sloping mesas and plateaus from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Shiprock Sheppard Mayqueen	60+ 60+ 60+	0-5 5-8 2-8	>6 >6 >6	7.4-8.4 7.9-8.4 7.9-8.4	<2 <2 <2	B A B	3 2 2	.24 .15 .24	5 5 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is good to poor, 8 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.
26.0-26.4	Du	Doak-Uffens: Deep, well drained, very fine sandy loam, sandy clay loam, fine sandy loam, and clay loam soils formed on level to gently sloping mesas and plateaus from alluvium derived primarily from sandstone and shale.	Doak Uffens	60+ 60+	0-3 0-3	>6 >6	7.4-8.4 7.4-8.4	<2 4-8	B D	3 3	.37 .20	5 1	Moderate wind and water erosion hazard, topsoil is fair to poor (excess clay or salt/sodium), 8 inch precipitation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
26.4-26.95	Sd	Sheppard-Mayqueen-Shiprock: Deep, somewhat excessively and well drained, loamy fine sand, fine sand, and fine sandy loam soils formed on level to moderately sloping mesas and plateaus from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Sheppard Mayqueen Shiprock	60+ 60+ 60+	5-8 2-8 0-5	>6 >6 >6	7.9-8.4 7.9-8.4 7.4-8.4	<2 <2 <2	A B B	2 2 3	.15 .24 .24	5 5 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to good, 8 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.
26.95-27.4	Du	Doak-Uffens: Deep, well drained, very fine sandy loam, sandy clay loam, fine sandy loam, and clay loam soils formed on level to gently sloping mesas and plateaus from alluvium derived primarily from sandstone and shale.	Doak Uffens	60+ 60+	0-3 0-3	>6 >6	7.4-8.4 7.4-8.4	<2 4-8	B D	3 3	.37 .20	5 1	Moderate wind and water erosion hazard, topsoil is fair to poor (excess clay or salt/sodium), 8 inch precipitation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
27.4-27.45	Sd	Sheppard-Mayqueen-Shiprock: Deep, somewhat excessively and well drained, loamy fine sand, fine sand, and fine sandy loam soils formed on level to moderately sloping mesas and plateaus from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Sheppard Mayqueen Shiprock	60+ 60+ 60+	5-8 2-8 0-5	>6 >6 >6	7.9-8.4 7.9-8.4 7.4-8.4	<2 <2 <2	A B B	2 2 3	.15 .24 .24	5 5 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to good, 8 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.
27.45-27.9	Du	Doak-Uffens: Deep, well drained, very fine sandy loam, sandy clay loam, fine sandy loam, and clay loam soils formed on level to gently sloping mesas and plateaus from alluvium derived primarily from sandstone and shale.	Doak Uffens	60+ 60+	0-3 0-3	>6 >6	7.4-8.4 7.4-8.4	<2 4-8	B D	3 3	.37 .20	5 1	Moderate wind and water erosion hazard, topsoil is fair to poor (excess clay or salt/sodium), 8 inch precipitation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
27.9-27.95	Sd	Sheppard-Mayqueen-Shiprock: Deep, somewhat excessively and well drained, loamy fine sand, fine sand, and fine sandy loam soils formed on level to moderately sloping mesas and plateaus from alluvial and eolian materials derived from sandstone, [illegible]le, an[illegible] source[illegible]	Sheppard Mayqueen Shiprock	60+ 60+ 60+	5-8 2-8 0-5	>6 >6 >6	7.9-8.4 7.9-8.4 7.4-8.4	<2 <2 <2	A B B	2 2 3	.15 .24 .24	5 5 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to good, 8 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to un[illegible]steel.

Table 3. CHARACTERISTICS OF THE SOILS IDENTIFIED ALONG MAIN WATER PIPELINE ROUTE P2 (continued)

Milepost	Map Symbol	Soil Phase, Series, Association, or Complex and Description	Soil Phase or Series	Depth to Bedrock (inches)	Slope (%)	Depth to High Water Table (feet)	Soil Reaction (pH)	Salinity (mmhos/cm)	Hydrologic Group	WEG Class	'K'	'T'	Comments
27.95-28.05	Du	Doak-Uffens: Deep, well drained, very fine sandy loam, sandy clay loam, fine sandy loam, and clay loam soils formed on level to gently sloping mesas and plateaus from alluvium derived primarily from sandstone and shale.	Doak Uffens	60+ 60+	0-3 0-3	>6 >6	7.4-8.4 7.4-8.4	<2 4-8	B D	3 3	.37 .20	5 1	Moderate wind and water erosion hazard, topsoil is fair to poor (excess clay or salt/sodium), 8 inch precipitation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
28.05-30.6	So/Sd	Shiprock-Sheppard-Mayqueen: Deep, somewhat excessively and well drained, loamy fine sand, fine sand, fine sandy loam, and sandy loam soils formed on level to moderately sloping mesas and plateaus from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Shiprock Sheppard Mayqueen	60+ 60+ 60+	0-5 5-8 2-8	>6 >6 >6	7.4-8.4 7.9-8.4 7.9-8.4	<2 <2 <2	B A B	3 2 2	.24 .15 .24	5 5 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is good to poor, 8 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.
30.6-30.9	Du	Doak-Uffens: Deep, well drained, very fine sandy loam, sandy clay loam, fine sandy loam, and clay loam soils formed on level to gently sloping mesas and plateaus from alluvium derived primarily from sandstone and shale.	Doak Uffens	60+ 60+	0-3 0-3	>6 >6	7.4-8.4 7.4-8.4	<2 4-8	B D	3 3	.37 .20	5 1	Moderate wind and water erosion hazard, topsoil is fair to poor (excess clay or salt/sodium), 8 inch precipitation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
30.9-31.3	SC	Sheppard-Huerfano-Notal: Deep and shallow, somewhat excessively and well drained, loamy fine sand, fine sand, sandy clay loam, clay loam, and clay soils formed on level to moderately sloping valley bottoms, fans, mesas, and plateaus from eolian, alluvial, and residual materials derived from sandstone, shale, and siltstone.	Sheppard Huerfano Notal	60+ 10-20 60+	2-8 0-3 0-2	>6 >6 >6	7.9-8.4 7.9-9.0 7.9-9.0	<2 >4 4-8	A D D	2 4L 4L	.15 .32 .32	5 1 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is fair to poor, 8 inch precipitation zone. Shrink-swell potential is low to high, exchangeable sodium content ranges from 15-75% for Huerfano-Notal portion, high corrosion hazard to uncoated steel.
31.3-31.75	Sd	Sheppard-Mayqueen-Shiprock: Deep, somewhat excessively and well drained, loamy fine sand, fine sand, and fine sandy loam soils formed on level to moderately sloping mesas and plateaus from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Sheppard Mayqueen Shiprock	60+ 60+ 60+	5-8 2-8 0-5	>6 >6 >6	7.9-8.4 7.9-8.4 7.4-8.4	<2 <2 <2	A B B	2 2 3	.15 .24 .24	5 5 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to good, 8 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.
31.75-31.8	DZ	Dune Land: Deep, excessively drained, unstabilized eolian sand and fine sand occuring on moderately sloping to steep mesas, plateaus, and in major drainageways.	Dune Land	60+	5-25	>6	NA	NA	NA	NA	NA	NA	High wind erosion hazard, low water erosion hazard, poor topsoil (too sandy, excess fines), 8 inch precipitation zone. Shrink-swell potential is low.
31.8-32.5	Sd	Sheppard-Mayqueen-Shiprock: Deep, somewhat excessively and well drained, loamy fine sand, fine sand, and fine sandy loam soils formed on level to moderately sloping mesas and plateaus from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Sheppard Mayqueen Shiprock	60+ 60+ 60+	5-8 2-8 0-5	>6 >6 >6	7.9-8.4 7.9-8.4 7.4-8.4	<2 <2 <2	A B B	2 2 3	.15 .24 .24	5 5 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to good, 8 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.
32.5-33.7	SC	Sheppard-Huerfano-Notal: Deep and shallow, somewhat excessively and well drained, loamy fine sand, fine sand, sandy clay loam, clay loam, and clay soils formed on level to moderately sloping valley bottoms, fans, mesas, and plateaus from eolian, alluvial, and residual materials derived from sandstone, shale, and siltstone.	Sheppard Huerfano Notal	60+ 10-20 60+	2-8 0-3 0-2	>6 >6 >6	7.9-8.4 7.9-9.0 7.9-9.0	<2 >4 4-8	A D D	2 4L 4L	.15 .32 .32	5 1 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is fair to poor, 8 inch precipitation zone. Shrink-swell potential is low to high, exchangeable sodium content ranges from 15-75% for Huerfano-Notal portion, high corrosion hazard to uncoated steel.

Table 3. CHARACTERISTICS OF THE SOILS IDENTIFIED ALONG MAIN WATER PIPELINE ROUTE P2 (continued)

Milepost	Map Symbol	Soil Phase, Series, Association, or Complex and Description[1]	Soil Phase or Series	Depth to Bedrock (inches)	Slope (%)	Depth to High Water Table (feet)	Soil Reaction (pH)	Salinity (mmhos/cm)	Hydrologic Group	WEG Class	'K'	'T'	Comments
33.7-36.2	BA	Badland: Moderately sloping to extremely steep, nonstony, barren shale uplands that are dissected by deep intermittent drainageways and gullies.	Badland	0	5-80	NA	NA	NA	NA	NA	NA	NA	8 inch precipitation zone.
36.2-37.9	SC	Sheppard-Huerfano-Notal: Deep and shallow, somewhat excessively and well drained, loamy fine sand, fine sand, sandy clay loam, clay loam, and clay soils formed on level to moderately sloping valley bottoms, fans, mesas, and plateaus from eolian, alluvial, and residual materials derived from sandstone, shale, and siltstone.	Sheppard Huerfano Notal	60+ 10-20 60+	2-8 0-3 0-2	>6 >6 >6	7.9-8.4 7.9-9.0 7.9-9.0	<2 >4 4-8	A D D	2 4L 4L	.15 .32 .32	5 1 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is fair to poor, 8 inch precipitation zone. Shrink-swell potential is low to high, exchangeable sodium content ranges from 15-75% for Huerfano-Notal portion, high corrosion hazard to uncoated steel.
37.9-38.3	BA	Badland: Moderately sloping to extremely steep, nonstony, barren shale uplands that are dissected by deep intermittent drainageways and gullies.	Badland	0	5-80	NA	NA	NA	NA	NA	NA	NA	8 inch precipitation zone.
38.3-38.85	SC	Sheppard-Huerfano-Notal: Deep and shallow, somewhat excessively and well drained, loamy fine sand, fine sand, sandy clay loam, clay loam, and clay soils formed on level to moderately sloping valley bottoms, fans, mesas, and plateaus from eolian, alluvial, and residual materials derived from sandstone, shale, and siltstone.	Sheppard Huerfano Notal	60+ 10-20 60+	2-8 0-3 0-2	>6 >6 >6	7.9-8.4 7.9-9.0 7.9-9.0	<2 >4 4-8	A D D	2 4L 4L	.15 .32 .32	5 1 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is fair to poor, 8 inch precipitation zone. Shrink-swell potential is low to high, exchangeable sodium content ranges from 15-75% for Huerfano-Notal portion, high corrosion hazard to uncoated steel.
38.85-38.95	RD	Riverwash-Duneland: Deep, poorly to excessively drained, unstabilized sandy, silty, clayey, and gravelly alluvium occurring on level and nearly level floodplains, streambeds, and arroyos; and unstabilized eolian sand occurring on nearly level to steep mesas, plateaus, and major drainageways.	Riverwash Duneland	60+ 60+	0-2 2-40	0-2[2] >6	NA NA	NA NA	D A	NA 1	NA .15	NA 5	Low and high (Duneland portion) wind erosion hazard, high (Riverwash portion) and low water erosion hazard, poor topsoil, 6-10 inch precipitation zone. Riverwash portion is frequently flooded, and shrink-swell potential is low.
38.95-39.5	TAB	Turley-Fruitland-Blancot: Deep, well drained, clay loam, loam, fine sandy loam, and sandy loam soils formed on level to moderately steep alluvial fans, upland valley sideslopes, and mesas from mixed alluvium derived from sandstone and shale.	Turley Fruitland Blancot	60+ 60+ 60+	0-5 0-30 0-5	>6 >6 >6	7.4-9.0 7.4-8.4 7.9-9.0	2-4 <4 2-4	B B B	3,4L 1,3,5 3,5	.37 .28 .28	5 5 5	Low to high (Fruitland portion) wind erosion hazard, moderate water erosion hazard, fair to good topsoil, 6-10 inch precipitation zone. These soils are mildly to strongly alkaline (calcareous), and shrink-swell potential is low to moderate.
39.5-40.1	SSH	Shiprock-Sheppard-Huerfano: Deep to shallow, well to somewhat excessively drained, fine sandy loam, fine sand, loamy fine sand, sandy clay loam, sandy loam, and clay loam soils. These soils formed on nearly level to strongly sloping mesas, plateaus, and upland valley bottoms from sandy alluvial and eolian materials derived from sandstone; and from alluvium, residuum, and loess derived from shale and siltstone.	Shiprock Sheppard Huerfano	60+ 60+ 10-20	0-8 1-12 0-3	>6 >6 >6	7.4-9.0 7.4-8.4 7.9-9.0	<4 <2 >4	B A D	2,3 1 3,4L	.24 .10 .32	5 5 1	Moderate to high wind erosion hazard, moderate to low water erosion hazard, good to poor topsoil, 6-10 inch precipitation zone. These soils are mildly to strongly alkaline (Huerfano portion is sodium affected), and shrink-swell potential is low to moderate.
40.1-40.65	TAB	Turley-Fruitland-Blancot: Deep, well drained, clay loam, loam, fine sandy loam, and sandy loam soils formed on level to moderately steep alluvial fans, upland valley sideslopes, and mesas from mixed all[illegible] erived [illegible]ndsto[illegible] hale.	Turley Fruitland Blancot	60+ 60+ 60+	0-5 0-30 0-5	>6 >6 >6	7.4-9.0 7.4-8.4 7.9-9.0	2-4 <4 2-4	B B B	3,4L 1,3,5 3,5	.37 .28 .28	5 5 5	Low to high (Fruitland portion) wind erosion hazard, moderate water erosion hazard, fair to good topsoil, 6-10 inch precipitation zone. These soils are mildly to strongly alkaline (calcareous), and shrink-swell poten- [illegible] is lo[illegible]derate

Table 3. CHARACTERISTICS OF THE SOILS IDENTIFIED ALONG MAIN WATER PIPELINE ROUTE P2 (concluded)

Milepost	Map Symbol	Soil Phase, Series, Association, or Complex and Description[1]	Soil Phase or Series	Depth to Bedrock (inches)	Slope (%)	Depth to High Water Table (feet)	Soil Reaction (pH)	Salinity (mmhos/cm)	Hydrologic Group	WEG Class	'K'	'T'	Comments
40.65–40.85	BR	Badland-Rock Outcrop: Nonstony, moderately sloping to extremely steep barren shale uplands that are dissected by deep intermittent drainageways and gullies; and barren sandstone exposures on moderately sloping to extremely steep ridges, benches, and escarpments.	Badland Rock Outcrop	0 0	5–80 5–80	>6 >6	NA NA	NA NA	D D	NA NA	NA NA	NA NA	Wind erosion hazard is low, Badland portion is susceptible to water erosion, topsoil is generally nonexistent (i.e., poor topsoil), 6–10 inch precipitation zone. Potential runoff on Badland portion is very rapid.
40.85–41.2	TAB	Turley-Fruitland-Blancot: Deep, well drained, clay loam, loam, fine sandy loam, and sandy loam soils formed on level to moderately steep alluvial fans, upland valley sideslopes, and mesas from mixed alluvium derived from sandstone and shale.	Turley Fruitland Blancot	60+ 60+ 60+	0–5 0–30 0–5	>6 >6 >6	7.4–9.0 7.4–8.4 7.9–9.0	2–4 <4 2–4	B B B	3,4L 1,3,5 3,5	.37 .28 .28	5 5 5	Low to high (Fruitland portion) wind erosion hazard, moderate water erosion hazard, fair to good topsoil, 6–10 inch precipitation zone. These soils are mildly to strongly alkaline (calcareous), and shrink-swell potential is low to moderate.
41.2–41.3	SSH	Shiprock-Sheppard-Huerfano: Deep to shallow, well to somewhat excessively drained, fine sandy loam, fine sand, loamy fine sand, sandy clay loam, sandy loam, and clay loam soils. These soils formed on nearly level to strongly sloping mesas, plateaus, and upland valley bottoms from sandy alluvial and eolian materials derived from sandstone; and from alluvium, residuum, and loess derived from shale and siltstone.	Shiprock Sheppard Huerfano	60+ 60+ 10–20	0–8 1–12 0–3	>6 >6 >6	7.4–9.0 7.4–8.4 7.9–9.0	<4 <2 >4	B A D	2,3 1 3,4L	.24 .10 .32	5 5 1	Moderate to high wind erosion hazard, moderate to low water erosion hazard, good to poor topsoil, 6–10 inch precipitation zone. These soils are mildly to strongly alkaline (Huerfano portion is sodium affected), and shrink-swell potential is low to moderate.
41.3–42.1	SC	Sheppard-Huerfano-Notal: Deep and shallow, somewhat excessively and well drained, loamy fine sand, fine sand, sandy clay loam, clay loam, and clay soils formed on level to moderately sloping valley bottoms, fans, mesas, and plateaus from eolian, alluvial, and residual materials derived from sandstone, shale, and siltstone.	Sheppard Huerfano Notal	60+ 10–20 60+	2–8 0–3 0–2	>6 >6 >6	7.9–8.4 7.9–9.0 7.9–9.0	<2 >4 4–8	A D D	2 4L 4L	.15 .32 .32	5 1 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is fair to poor, 8 inch precipitation zone. Shrink-swell potential is low to high, exchangeable sodium content ranges from 15–75% for Huerfano-Notal portion, high corrosion hazard to uncoated steel.
42.1–42.45	BA	Badland: Moderately sloping to extremely steep, nonstony, barren shale uplands that are dissected by deep intermittent drainageways and gullies.	Badland	0	5–80	NA	NA	NA	NA	NA	NA	NA	8 inch precipitation zone.
42.45–42.6	SC	Sheppard-Huerfano-Notal: Deep and shallow, somewhat excessively and well drained, loamy fine sand, fine sand, sandy clay loam, clay loam, and clay soils formed on level to moderately sloping valley bottoms, fans, mesas, and plateaus from eolian, alluvial, and residual materials derived from sandstone, shale, and siltstone.	Sheppard Huerfano Notal	60+ 10–20 60+	2–8 0–3 0–2	>6 >6 >6	7.9–8.4 7.9–9.0 7.9–9.0	<2 >4 4–8	A D D	2 4L 4L	.15 .32 .32	5 1 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is fair to poor, 8 inch precipitation zone. Shrink-swell potential is low to high, exchangeable sodium content ranges from 15–75% for Huerfano-Notal portion, high corrosion hazard to uncoated steel.

NA = Not available or not applicable.

[1] Sources:

(1) U.S. Soil Conservation Service (SCS). 1980. Soil survey of San Juan County, New Mexico, eastern part. (For Mileposts 0.0–38.85 and 41.3–42.6.)

(2) Buchanan, B. 1978. Soils field research, soils map. Prepared (under contract) for Public Service Company of New Mexico. Albuquerque, New Mexico. (And applicable SCS Form 5 – Soil Interpretation Tables.) (For Mileposts 38.85–41.3.)

textures (e.g., too sandy or clayey) or excess salt/sodium. The Blackston (0.3 mile), Persayo (2.90 miles), and Muff (0.8 mile) soils traversed by the P2 route are difficult to reclaim if the topsoil is removed and not replaced. Susceptibility to wind-induced soil erosion ranges from low to high, but it is primarily moderate to high. Susceptibility to water-induced soil erosion is primarily low to moderate. The soils identified along this alternative main water pipeline route are mildly to strongly alkaline. Shrink-swell potential of the identified soils is primarily low to moderate, but the Notal soil has a high shrink-swell potential. These soils are currently used primarily for livestock grazing, wildlife habitat, and to a lesser extent irrigated cropland and energy resource development. This pipeline route traverses developed portions of NIIP Block 4 (MP 5.5-13 and 15.5-18). Additionally, this pipeline route traverses the following undeveloped portions of NIIP Block 11: MP 18-19, 28-30, and 31.75-33. These undeveloped portions have been determined to be irrigable.

Main Water Pipeline Alternative P3. Alternative pipeline route P3 is also within the San Juan River Valley Mesas and Plateaus portion of the Western Range and Irrigated Region (SCS 1978a). Annual precipitation is usually about 8 inches along this route. Thirteen different soil phases, series, associations, or complexes were identified along P3. Table 4 lists (by mileposts) and characterizes the identified soils.

The soils identified along this alternative pipeline route are primarily deep and well to somewhat excessively drained. Surface textures range from fine sand to clay. These soils are forming in alluvial, eolian, and residual materials derived primarily from sandstone, shale, and siltstone on mesas, plateaus, hills, breaks, canyons, upland valleys, alluvial fans, intermittent drainageways,

Table 4. CHARACTERISTICS OF THE SOILS IDENTIFIED ALONG MAIN WATER PIPELINE ROUTE P3

Milepost	Map Symbol	Soil Phase, Series, Association, or Complex and Description	Soil Phase or Series	Depth to Bedrock (inches)	Slope (%)	Depth to High Water Table (feet)	Soil Reaction (pH)	Salinity (mmhos/cm)	Hydrologic Group	WEG Class	'K'	'T'	Comments
0.0–0.25	Fy	Fruitland-Slickspots: Deep, well and poorly drained, sandy loam soils formed on level to gently sloping fans and valleys from alluvium derived primarily from sandstone and shale. Includes Slickspots areas which are strongly alkali affected, and are easily puddled and crusted.	Fruitland	60+	0–3	>6	7.4–8.4	<4	B	3	.24	5	Moderate wind and water erosion hazard, topsoil is good (Slickspots areas are poor), 8 inch precipitation zone. Shrink-swell potential is low, Slickspots areas contain 15-50% exchangeable sodium (addition of gypsum reduces associated problems).
0.25–0.30	HA	Haplargids-Blackston-Torriorthents: Shallow to deep, well to excessively drained, cobbly sandy loam, cobbly sandy clay loam, gravelly loam, gravelly clay loam, cobbly loam, and clay loam soils formed on moderately sloping to steep terraces, mesas, and plateaus from alluvium derived from mixed sources.	Haplargids Blackston Torriorthents	10–60+ 60+ 10–20	8–50 8–40 8–50	NA >6 NA	NA 7.9–8.4 NA	NA 2–4 NA	NA B NA	NA 5 NA	NA .17 NA	NA 1 NA	Low wind erosion hazard, low to high water erosion hazard, poor topsoil (area reclaim), 9 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.
0.30–0.75	Ay/Ax	Avalon: Deep, well drained, loam, and sandy loam soils formed on level to moderately sloping mesas and plateaus from alluvial and eolian materials derived primarily from sandstone and shale.	Avalon	60+	0–8	>6	7.9–8.4	2–8	B	4L,3	.43, .37	3	Moderate wind erosion hazard, moderate to high water erosion hazard, fair topsoil (excess salt), 8 inch precipitation zone. Shrink-swell potential is low, soil is slightly saline, high corrosion hazard to uncoated steel.
0.75–1.55	FX	Fruitland-Persayo-Sheppard: Deep and shallow, well to somewhat excessively drained, sandy loam, fine sandy loam, clay loam, loamy fine sand, and fine sand soils formed on moderately sloping to moderately steep hills, mesas, plateaus, fans, and breaks from alluvium, residuum, and eolian materials derived from sandstone and shale.	Fruitland Persayo Sheppard	60+ 10–20 60+	5–30 5–30 5–30	>6 >6 >6	7.4–8.4 7.9–9.0 7.9–8.4	<4 <8 <2	B D A	3 4L 2	.24 .37 .15	5 1 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor (Persayo portion-area reclaim), 8 inch precipitation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
1.55–1.70	Sh	Shiprock: Deep, well drained, loamy fine sand, fine sandy loam, and sandy loam soils formed on level and nearly level mesas and plateaus from alluvial and eolian materials derived primarily from sandstone and shale.	Shiprock	60+	0–2	>6	7.4–8.4	<2	B	2	.15	5	High wind erosion hazard, low water erosion hazard, good topsoil, 8 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.
1.70–2.85	FX	Fruitland-Persayo-Sheppard: Deep and shallow, well to somewhat excessively drained, sandy loam, fine sandy loam, clay loam, loamy fine sand, and fine sand soils formed on moderately sloping to moderately steep hills, mesas, plateaus, fans, and breaks from alluvium, residuum, and eolian materials derived from sandstone and shale.	Fruitland Persayo Sheppard	60+ 10–20 60+	5–30 5–30 5–30	>6 >6 >6	7.4–8.4 7.9–9.0 7.9–8.4	<4 <8 <2	B D A	3 4L 2	.24 .37 .15	5 1 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor (Persayo portion-area reclaim), 8 inch precipitation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
2.85–3.55	DN	Doak-Avalon: Deep, well drained, loam, and clayey loam soils formed on level to gently sloping mesas, plateaus, and terraces from alluvial and eolian materials derived primarily from sandstone and shale.	Doak Avalon	60+ 60+	0–5 3–5	>6 >6	7.4–8.4 7.9–8.4	>2 2–8	B B	5 4L	.37 .43	5 3	Low to moderate wind erosion hazard, moderate to high water erosion hazard, fair topsoil (excess clay/salt), 8 inch precipitation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
3.55–7.0	DS	Doak-Sheppard-Shiprock: Deep, well and somewhat excessively drained, loam, clay loam, loamy fine sand, fine sand, and fine sandy loam soils formed on level to strongly sloping mesas, plateaus, and terraces from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Doak Sheppard Shiprock	60+ 60+ 60+	0–5 0–15 0–15	>6 >6 >6	7.4–8.4 7.9–8.4 7.4–8.4	<2 <2 <2	B A B	5 2 3	.37 .15 .24	5 5 5	Low to high wind erosion hazard, low to moderate water erosion hazard, fair to good topsoil, 8 inch precipitation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.

Table 4. CHARACTERISTICS OF THE SOILS IDENTIFIED ALONG MAIN WATER PIPELINE ROUTE P3 (continued)

Milepost	Map Symbol	Soil Phase, Series, Association, or Complex and Description[1]	Soil Phase or Series	Depth to Bedrock (inches)	Slope (%)	Depth to High Water Table (feet)	Soil Reaction (pH)	Salinity (mmhos/cm)	Hydrologic Group	WEG Class	'K'	'T'	Comments
7.0-9.25	FX	Fruitland-Persayo-Sheppard: Deep and shallow, well to somewhat excessively drained, sandy loam, fine sandy loam, clay loam, loamy fine sand, and fine sand soils formed on moderately sloping to moderately steep hills, mesas, plateaus, fans, and breaks from alluvium, residuum, and eolian materials derived from sandstone and shale.	Fruitland Persayo Sheppard	60+ 10-20 60+	5-30 5-30 5-30	>6 >6 >6	7.4-8.4 7.9-9.0 7.9-8.4	<4 <8 <2	B D A	3 4L 2	.24 .37 .15	5 1 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor (Persayo portion-area reclaim), 8 inch precipitation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
9.25-9.9	BA	Badland: Moderately sloping to extremely steep, nonstony, barren shale uplands that are dissected by deep intermittent drainageways and gullies.	Badland	0	5-80	NA	NA	NA	NA	NA	NA	NA	8 inch precipitation zone.
9.9-10.4	BT	Blancot-Notal: Deep, well drained, loam, clay loam, silty clay loam, and clay soils formed on level to gently sloping alluvial fans and upland valleys from alluvium derived primarily from sandstone and shale.	Blancot Notal	60+ 60+	0-5 0-2	>6 >6	7.9-8.4 7.9-9.0	<2 4-8	B D	6 4L	.32 .32	5 5	Low to moderate wind erosion hazard, moderate water erosion hazard, topsoil is fair to poor (too clayey), 8 inch precipitation zone. Shrink-swell potential is low to high, high corrosion hazard to uncoated steel.
10.4-10.6	BA	Badland: Moderately sloping to extremely steep, nonstony, barren shale uplands that are dissected by deep intermittent drainageways and gullies.	Badland	0	5-80	NA	NA	NA	NA	NA	NA	NA	8 inch precipitation zone.
10.6-10.85	FA	Farb-Persayo-Rock Outcrop: Very shallow to shallow, excessively and well drained, fine sandy loam, sandy clay loam, clay loam and silty clay loam soils formed on gently sloping to moderately steep hills and breaks from residuum derived from sandstone and shale. Includes barren sandstone outcrops on strongly sloping to moderately steep benches, ridges, and breaks.	Farb Persayo Rock Outcrop	5-20 10-20 0	3-30 3-30 10-30	>6 >6 >6	7.4-8.4 7.9-9.0 NA	<2 <8 NA	D D NA	3 4L NA	.32 .37 NA	1 1 NA	Moderate wind and water erosion hazard, poor topsoil (Persayo portion-area reclaim), 8 inch precipitation zone. Shrink-swell potential is low to moderate, low to high corrosion hazard to uncoated steel.
10.85-11.3	BA	Badland: Moderately sloping to extremely steep, nonstony, barren shale uplands that are dissected by deep intermittent drainageways and gullies.	Badland	0	5-80	NA	NA	NA	NA	NA	NA	NA	8 inch precipitation zone.
11.3-11.4	RA	Riverwash: Deep, well to excessively drained, unstabilized sandy, silty, clayey, or gravelly sediment on level to gently sloping floodplains, streambeds, riverbeds, and in arroyos.	Riverwash	60+	0-3	NA	NA	NA	NA	NA	NA	NA	Highly susceptible to water erosion and reworking, frequently flooded, 8 inch precipitation zone.
11.4-12.05	BA	Badland: Moderately sloping to extremely steep, nonstony, barren shale uplands that are dissected by deep intermittent drainageways and gullies.	Badland	0	5-80	NA	NA	NA	NA	NA	NA	NA	8 inch precipitation zone.
12.05-12.8	DS	Doak-Sheppard-Shiprock: Deep, well and somewhat excessively drained, loam, clay loam, loamy fine sand, fine sand, and fine sandy loam soils formed on level to strongly sloping mesas, plateaus, and terraces from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Doak Sheppard Shiprock	60+ 60+ 60+	0-5 0-15 0-15	>6 >6 >6	7.4-8.4 7.9-8.4 7.4-8.4	<2 <2 <2	B A B	5 2 3	.37 .15 .24	5 5 5	Low to high wind erosion hazard, low to moderate water erosion hazard, fair to good topsoil, 8 inch precipitation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
12.8-13.15	BA	Badland: Moderately sloping to extremely steep, nonstony, barren shale uplands that ected inter drainag and gul	Badland	0	5-80	NA	NA	NA	NA	NA	NA	NA	8 inch precipitation zone.

Table 4. CHARACTERISTICS OF THE SOILS IDENTIFIED ALONG MAIN WATER PIPELINE ROUTE P3 (continued)

Milepost	Map Symbol	Soil Phase, Series, Association, or Complex and Description[1]	Soil Phase or Series	Depth to Bedrock (inches)	Slope (%)	Depth to High Water Table (feet)	Soil Reaction (pH)	Salinity (mmhos/ cm)	Hydrologic Group	WEG Class	'K'	'T'	Comments
13.15-13.7	DS	Doak-Sheppard-Shiprock: Deep, well and somewhat excessively drained, loam, clay loam, loamy fine sand, fine sand, and fine sandy loam soils formed on level to strongly sloping mesas, plateaus, and terraces from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Doak Sheppard Shiprock	60+ 60+ 60+	0-5 0-15 0-15	>6 >6 >6	7.4-8.4 7.9-8.4 7.4-8.4	<2 <2 <2	B A B	5 2 3	.37 .15 .24	5 5 5	Low to high wind erosion hazard, low to moderate water erosion hazard, fair to good topsoil, 8 inch precipitation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
13.7-16.0	BA	Badland: Moderately sloping to extremely steep, nonstony, barren shale uplands that are dissected by deep intermittent drainageways and gullies.	Badland	0	5-80	NA	NA	NA	NA	NA	NA	NA	8 inch precipitation zone.
16.0-20.9	DS	Doak-Sheppard-Shiprock: Deep, well and somewhat excessively drained, loam, clay loam, loamy fine sand, fine sand, and fine sandy loam soils formed on level to strongly sloping mesas, plateaus, and terraces from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Doak Sheppard Shiprock	60+ 60+ 60+	0-5 0-15 0-15	>6 >6 >6	7.4-8.4 7.9-8.4 7.4-8.4	<2 <2 <2	B A B	5 2 3	.37 .15 .24	5 5 5	Low to high wind erosion hazard, low to moderate water erosion hazard, fair to good topsoil, 8 inch precipitation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
20.9-21.15	BT	Blancot-Notal: Deep, well drained, loam, clay loam, silty clay loam, and clay soils formed on level to gently sloping alluvial fans and upland valleys from alluvium derived primarily from sandstone and shale.	Blancot Notal	60+ 60+	0-5 0-2	>6 >6	7.9-8.4 7.9-9.0	<2 4-8	B D	6 4L	.32 .32	5 5	Low to moderate wind erosion hazard, moderate water erosion hazard, topsoil is fair to poor (too clayey), 8 inch precipitation zone. Shrink-swell potential is low to high, high corrosion hazard to uncoated steel.
21.15-23.75	DS	Doak-Sheppard-Shiprock: Deep, well and somewhat excessively drained, loam, clay loam, loamy fine sand, fine sand, and fine sandy loam soils formed on level to strongly sloping mesas, plateaus, and terraces from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Doak Sheppard Shiprock	60+ 60+ 60+	0-5 0-15 0-15	>6 >6 >6	7.4-8.4 7.9-8.4 7.4-8.4	<2 <2 <2	B A B	5 2 3	.37 .15 .24	5 5 5	Low to high wind erosion hazard, low to moderate water erosion hazard, fair to good topsoil, 8 inch precipitation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
23.75-23.8	FX	Fruitland-Persayo-Sheppard: Deep and shallow, well to somewhat excessively drained, sandy loam, fine sandy loam, clay loam, loamy fine sand, and fine sand soils formed on moderately sloping to moderately steep hills, mesas, plateaus, fans, and breaks from alluvium, residuum, and eolian materials derived from sandstone and shale.	Fruitland Persayo Sheppard	60+ 10-20 60+	5-30 5-30 5-30	>6 >6 >6	7.4-8.4 7.9-9.0 7.9-8.4	<4 <8 <2	B D A	3 4L 2	.24 .37 .15	5 1 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor (Persayo portion-area reclaim), 8 inch precipitation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
23.8-24.9	DS	Doak-Sheppard-Shiprock: Deep, well and somewhat excessively drained, loam, clay loam, loamy fine sand, fine sand, and fine sandy loam soils formed on level to strongly sloping mesas, plateaus, and terraces from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Doak Sheppard Shiprock	60+ 60+ 60+	0-5 0-15 0-15	>6 >6 >6	7.4-8.4 7.9-8.4 7.4-8.4	<2 <2 <2	B A B	5 2 3	.37 .15 .24	5 5 5	Low to high wind erosion hazard, low to moderate water erosion hazard, fair to good topsoil, 8 inch precipitation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
24.9-25.45	FX	Fruitland-Persayo-Sheppard: Deep and shallow, well to somewhat excessively drained, sandy loam, fine sandy loam, clay loam, loamy fine sand, and fine sand soils formed on moderately sloping to moderately steep hills, mesas, plateaus, fans, and breaks from alluvium, residuum, and eolian materials derived from sandstone and shale.	Fruitland Persayo Sheppard	60+ 10-20 60+	5-30 5-30 5-30	>6 >6 >6	7.4-8.4 7.9-9.0 7.9-8.4	<4 <8 <2	B D A	3 4L 2	.24 .37 .15	5 1 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor (Persayo portion-area reclaim), 8 inch precipitation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.

Table 4. CHARACTERISTICS OF THE SOILS IDENTIFIED ALONG MAIN WATER PIPELINE ROUTE P3 (continued)

Milepost	Map Symbol	Soil Phase, Series, Association, or Complex and Description[1]	Soil Phase or Series	Depth to Bedrock (inches)	Slope (%)	Depth to High Water Table (feet)	Soil Reaction (pH)	Salinity (mmhos/cm)	Hydrologic Group	WEG Class	'K'	'T'	Comments
25.45-25.7	DS	Doak-Sheppard-Shiprock: Deep, well and somewhat excessively drained, loam, clay loam, loamy fine sand, fine sand, and fine sandy loam soils formed on level to strongly sloping mesas, plateaus, and terraces from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Doak Sheppard Shiprock	60+ 60+ 60+	0-5 0-15 0-15	>6 >6 >6	7.4-8.4 7.9-8.4 7.4-8.4	<2 <2 <2	B A B	5 2 3	.37 .15 .24	5 5 5	Low to high wind erosion hazard, low to moderate water erosion hazard, fair to good topsoil, 8 inch precipitation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
25.7-26.05	FX	Fruitland-Persayo-Sheppard: Deep and shallow, well to somewhat excessively drained, sandy loam, fine sandy loam, clay loam, loamy fine sand, and fine sand soils formed on moderately sloping to moderately steep hills, mesas, plateaus, fans, and breaks from alluvium, residuum, and eolian materials derived from sandstone and shale.	Fruitland Persayo Sheppard	60+ 10-20 60+	5-30 5-30 5-30	>6 >6 >6	7.4-8.4 7.9-9.0 7.9-8.4	<4 <8 <2	B D A	3 4L 2	.24 .37 .15	5 1 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor (Persayo portion-area reclaim), 8 inch precipitation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
26.05-26.45	BT	Blancot-Notal: Deep, well drained, loam, clay loam, silty clay loam, and clay soils formed on level to gently sloping alluvial fans and upland valleys from alluvium derived primarily from sandstone and shale.	Blancot Notal	60+ 60+	0-5 0-2	>6 >6	7.9-8.4 7.9-9.0	<2 4-8	B D	6 4L	.32 .32	5 5	Low to moderate wind erosion hazard, moderate water erosion hazard, topsoil is fair to poor (too clayey), 8 inch precipitation zone. Shrink-swell potential is low to high, high corrosion hazard to uncoated steel.
26.45-28.15	DS	Doak-Sheppard-Shiprock: Deep, well and somewhat excessively drained, loam, clay loam, loamy fine sand, fine sand, and fine sandy loam soils formed on level to strongly sloping mesas, plateaus, and terraces from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Doak Sheppard Shiprock	60+ 60+ 60+	0-5 0-15 0-15	>6 >6 >6	7.4-8.4 7.9-8.4 7.4-8.4	<2 <2 <2	B A B	5 2 3	.37 .15 .24	5 5 5	Low to high wind erosion hazard, low to moderate water erosion hazard, fair to good topsoil, 8 inch precipitation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
28.15-28.25	FX	Fruitland-Persayo-Sheppard: Deep and shallow, well to somewhat excessively drained, sandy loam, fine sandy loam, clay loam, loamy fine sand, and fine sand soils formed on moderately sloping to moderately steep hills, mesas, plateaus, fans, and breaks from alluvium, residuum, and eolian materials derived from sandstone and shale.	Fruitland Persayo Sheppard	60+ 10-20 60+	5-30 5-30 5-30	>6 >6 >6	7.4-8.4 7.9-9.0 7.9-8.4	<4 <8 <2	B D A	3 4L 2	.24 .37 .15	5 1 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor (Persayo portion-area reclaim), 8 inch precipitation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
28.25-28.28	BT	Blancot-Notal: Deep, well drained, loam, clay loam, silty clay loam, and clay soils formed on level to gently sloping alluvial fans and upland valleys from alluvium derived primarily from sandstone and shale.	Blancot Notal	60+ 60+	0-5 0-2	>6 >6	7.9-8.4 7.9-9.0	<2 4-8	B D	6 4L	.32 .32	5 5	Low to moderate wind erosion hazard, moderate water erosion hazard, topsoil is fair to poor (too clayey), 8 inch precipitation zone. Shrink-swell potential is low to high, high corrosion hazard to uncoated steel.
28.28-28.4	FX	Fruitland-Persayo-Sheppard: Deep and shallow, well to somewhat excessively drained, sandy loam, fine sandy loam, clay loam, loamy fine sand, and fine sand soils formed on moderately sloping to moderately steep hills, mesas, plateaus, fans, and breaks from alluvium, residuum, and eolian materials derived from sandstone and shale.	Fruitland Persayo Sheppard	60+ 10-20 60+	5-30 5-30 5-30	>6 >6 >6	7.4-8.4 7.9-9.0 7.9-8.4	<4 <8 <2	B D A	3 4L 2	.24 .37 .15	5 1 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor (Persayo portion-area reclaim), 8 inch precipitation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
28.4-28.6	BT	Blancot-Notal: Deep, well drained, loam, clay loam, silty clay loam, and clay soils formed on level to gently sloping alluvial fans and upland valleys from alluvium derived primarily from sandstone and shale.	Blancot Notal	60+ 60+	0-5 0-2	>6 >6	7.9-8.4 7.9-9.0	<2 4-8	B D	6 4L	.32 .32	5 5	Low to moderate wind erosion hazard, moderate water erosion hazard, topsoil is fair to poor (too clayey), 8 inch precipitation zone. Shrink-swell potential is low to high, high [illegible]sion h[illegible] uncoa[illegible]el.

Table 4. CHARACTERISTICS OF THE SOILS IDENTIFIED ALONG MAIN WATER PIPELINE ROUTE P3 (continued)

Milepost	Map Symbol	Soil Phase, Series, Association, or Complex and Description[1]	Soil Phase or Series	Depth to Bedrock (inches)	Slope (%)	Depth to High Water Table (feet)	Soil Reaction (pH)	Salinity (mmhos/cm)	Hydrologic Group	WEG Class	'K'	'T'	Comments
28.6-28.7	FX	Fruitland-Persayo-Sheppard: Deep and shallow, well to somewhat excessively drained, sandy loam, fine sandy loam, clay loam, loamy fine sand, and fine sand soils formed on moderately sloping to moderately steep hills, mesas, plateaus, fans, and breaks from alluvium, residuum, and eolian materials derived from sandstone and shale.	Fruitland Persayo Sheppard	60+ 10-20 60+	5-30 5-30 5-30	>6 >6 >6	7.4-8.4 7.9-9.0 7.9-8.4	<4 <8 <2	B D A	3 4L 2	.24 .37 .15	5 1 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor (Persayo portion-area reclaim), 8 inch precipitation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
28.7-29.45	DS	Doak-Sheppard-Shiprock: Deep, well and somewhat excessively drained, loam, clay loam, loamy fine sand, fine sand, and fine sandy loam soils formed on level to strongly sloping mesas, plateaus, and terraces from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Doak Sheppard Shiprock	60+ 60+ 60+	0-5 0-15 0-15	>6 >6 >6	7.4-8.4 7.9-8.4 7.4-8.4	<2 <2 <2	B A B	5 2 3	.37 .15 .24	5 5 5	Low to high wind erosion hazard, low to moderate water erosion hazard, fair to good topsoil, 8 inch precipitation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
29.45-29.75	FX	Fruitland-Persayo-Sheppard: Deep and shallow, well to somewhat excessively drained, sandy loam, fine sandy loam, clay loam, loamy fine sand, and fine sand soils formed on moderately sloping to moderately steep hills, mesas, plateaus, fans, and breaks from alluvium, residuum, and eolian materials derived from sandstone and shale.	Fruitland Persayo Sheppard	60+ 10-20 60+	5-30 5-30 5-30	>6 >6 >6	7.4-8.4 7.9-9.0 7.9-8.4	<4 <8 <2	B D A	3 4L 2	.24 .37 .15	5 1 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor (Persayo portion-area reclaim), 8 inch precipitation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
29.75-31.55	DS	Doak-Sheppard-Shiprock: Deep, well and somewhat excessively drained, loam, clay loam, loamy fine sand, fine sand, and fine sandy loam soils formed on level to strongly sloping mesas, plateaus, and terraces from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Doak Sheppard Shiprock	60+ 60+ 60+	0-5 0-15 0-15	>6 >6 >6	7.4-8.4 7.9-8.4 7.4-8.4	<2 <2 <2	B A B	5 2 3	.37 .15 .24	5 5 5	Low to high wind erosion hazard, low to moderate water erosion hazard, fair to good topsoil, 8 inch precipitation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
31.55-32.4	FX	Fruitland-Persayo-Sheppard: Deep and shallow, well to somewhat excessively drained, sandy loam, fine sandy loam, clay loam, loamy fine sand, and fine sand soils formed on moderately sloping to moderately steep hills, mesas, plateaus, fans, and breaks from alluvium, residuum, and eolian materials derived from sandstone and shale.	Fruitland Persayo Sheppard	60+ 10-20 60+	5-30 5-30 5-30	>6 >6 >6	7.4-8.4 7.9-9.0 7.9-8.4	<4 <8 <2	B D A	3 4L 2	.24 .37 .15	5 1 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor (Persayo portion-area reclaim), 8 inch precipitation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
32.4-32.65	BT	Blancot-Notal: Deep, well drained, loam, clay loam, silty clay loam, and clay soils formed on level to gently sloping alluvial fans and upland valleys from alluvium derived primarily from sandstone and shale.	Blancot Notal	60+ 60+	0-5 0-2	>6 >6	7.9-8.4 7.9-9.0	<2 4-8	B D	6 4L	.32 .32	5 5	Low to moderate wind erosion hazard, moderate water erosion hazard, topsoil is fair to poor (too clayey), 8 inch precipitation zone. Shrink-swell potential is low to high, high corrosion hazard to uncoated steel.
32.65-33.0	FX	Fruitland-Persayo-Sheppard: Deep and shallow, well to somewhat excessively drained, sandy loam, fine sandy loam, clay loam, loamy fine sand, and fine sand soils formed on moderately sloping to moderately steep hills, mesas, plateaus, fans, and breaks from alluvium, residuum, and eolian materials derived from sandstone and shale.	Fruitland Persayo Sheppard	60+ 10-20 60+	5-30 5-30 5-30	>6 >6 >6	7.4-8.4 7.9-9.0 7.9-8.4	<4 <8 <2	B D A	3 4L 2	.24 .37 .15	5 1 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor (Persayo portion-area reclaim), 8 inch precipitation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
33.0-33.3	BT	Blancot-Notal: Deep, well drained, loam, clay loam, silty clay loam, and clay soils formed on level to gently sloping alluvial fans and upland valleys from alluvium derived primarily from sandstone and shale.	Blancot Notal	60+ 60+	0-5 0-2	>6 >6	7.9-8.4 7.9-9.0	<2 4-8	B D	6 4L	.32 .32	5 5	Low to moderate wind erosion hazard, moderate water erosion hazard, topsoil is fair to poor (too clayey), 8 inch precipitation zone. Shrink-swell potential is low to high, high corrosion hazard to uncoated steel.

Table 4. CHARACTERISTICS OF THE SOILS IDENTIFIED ALONG MAIN WATER PIPELINE ROUTE P3 (continued)

Milepost	Map Symbol	Soil Phase, Series, Association,[1] or Complex and Description	Soil Phase or Series	Depth to Bedrock (inches)	Slope (%)	Depth to High Water Table (feet)	Soil Reaction (pH)	Salinity (mmhos/cm)	Hydrologic Group	WEG Class	'K'	'T'	Comments
33.3-34.4	DS	Doak-Sheppard-Shiprock: Deep, well and somewhat excessively drained, loam, clay loam, loamy fine sand, fine sand, and fine sandy loam soils formed on level to strongly sloping mesas, plateaus, and terraces from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Doak Sheppard Shiprock	60+ 60+ 60+	0-5 0-15 0-15	>6 >6 >6	7.4-8.4 7.9-8.4 7.4-8.4	<2 <2 <2	B A B	5 2 3	.37 .15 .24	5 5 5	Low to high wind erosion hazard, low to moderate water erosion hazard, fair to good topsoil, 8 inch precipitation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
34.4-34.65	BA	Badland: Moderately sloping to extremely steep, nonstony, barren shale uplands that are dissected by deep intermittent drainageways and gullies.	Badland	0	5-80	NA	NA	NA	NA	NA	NA	NA	8 inch precipitation zone.
34.65-35.95	DS	Doak-Sheppard-Shiprock: Deep, well and somewhat excessively drained, loam, clay loam, loamy fine sand, fine sand, and fine sandy loam soils formed on level to strongly sloping mesas, plateaus, and terraces from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Doak Sheppard Shiprock	60+ 60+ 60+	0-5 0-15 0-15	>6 >6 >6	7.4-8.4 7.9-8.4 7.4-8.4	<2 <2 <2	B A B	5 2 3	.37 .15 .24	5 5 5	Low to high wind erosion hazard, low to moderate water erosion hazard, fair to good topsoil, 8 inch precipitation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
35.95-36.15	FX	Fruitland-Persayo-Sheppard: Deep and shallow, well to somewhat excessively drained, sandy loam, fine sandy loam, clay loam, loamy fine sand, and fine sand soils formed on moderately sloping to moderately steep hills, mesas, plateaus, fans, and breaks from alluvium, residuum, and eolian materials derived from sandstone and shale.	Fruitland Persayo Sheppard	60+ 10-20 60+	5-30 5-30 5-30	>6 >6 >6	7.4-8.4 7.9-9.0 7.9-8.4	<4 <8 <2	B D A	3 4L 2	.24 .37 .15	5 1 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor (Persayo portion-area reclaim), 8 inch precipitation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
36.15-36.45	BT	Blancot-Notal: Deep, well drained, loam, clay loam, silty clay loam, and clay soils formed on level to gently sloping alluvial fans and upland valleys from alluvium derived primarily from sandstone and shale.	Blancot Notal	60+ 60+	0-5 0-2	>6 >6	7.9-8.4 7.9-9.0	<2 4-8	B D	6 4L	.32 .32	5 5	Low to moderate wind erosion hazard, moderate water erosion hazard, topsoil is fair to poor (too clayey), 8 inch precipitation zone. Shrink-swell potential is low to high, high corrosion hazard to uncoated steel.
36.45-37.5	DS	Doak-Sheppard-Shiprock: Deep, well and somewhat excessively drained, loam, clay loam, loamy fine sand, fine sand, and fine sandy loam soils formed on level to strongly sloping mesas, plateaus, and terraces from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Doak Sheppard Shiprock	60+ 60+ 60+	0-5 0-15 0-15	>6 >6 >6	7.4-8.4 7.9-8.4 7.4-8.4	<2 <2 <2	B A B	5 2 3	.37 .15 .24	5 5 5	Low to high wind erosion hazard, low to moderate water erosion hazard, fair to good topsoil, 8 inch precipitation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
37.5-38.3	SC	Sheppard-Huerfano-Notal: Deep and shallow, somewhat excessively and well drained, loamy fine sand, fine sand, sandy clay loam, clay loam, and clay soils formed on level to moderately sloping valley bottoms, fans, mesas, and plateaus from eolian, alluvial, and residual materials derived from sandstone, shale, and siltstone.	Sheppard Huerfano Notal	60+ 10-20 60+	2-8 0-3 0-2	>6 >6 >6	7.9-8.4 7.9-9.0 7.9-9.0	<2 >4 4-8	A D D	2 4L 4L	.15 .32 .32	5 1 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is fair to poor, 8 inch precipitation zone. Shrink-swell potential is low to high, exchangeable sodium content ranges from 15-75% for Huerfano-Notal portion, high corrosion hazard to uncoated steel.
38.3-42.35	BT	Blancot-Notal: Deep, well drained, loam, clay loam, silty clay loam, and clay soils formed on level to gently sloping alluvial fans and upland valleys from alluvium derived primarily from sandstone and shale.	Blancot Notal	60+ 60+	0-5 0-2	>6 >6	7.9-8.4 7.9-9.0	<2 4-8	B D	6 4L	.32 .32	5 5	Low to moderate wind erosion hazard, moderate water erosion hazard, topsoil is fair to poor (too clayey), 8 inch precipitation zone. Shrink-swell potential is low to high, high [illegible]rosion [illegible] to un[illegible]teel.

Table 4. CHARACTERISTICS OF THE SOILS IDENTIFIED ALONG MAIN WATER PIPELINE ROUTE P3 (concluded)

Milepost	Map Symbol	Soil Phase, Series, Association, or Complex and Description[1]	Soil Phase or Series	Depth to Bedrock (inches)	Slope (%)	Depth to High Water Table (feet)	Soil Reaction (pH)	Salinity (mmhos/ cm)	Hydro-logic Group	WEG Class	'K'	'T'	Comments
42.35-43.9	SC	Sheppard-Huerfano-Notal: Deep and shallow, somewhat excessively and well drained, loamy fine sand, fine sand, sandy clay loam, clay loam, and clay soils formed on level to moderately sloping valley bottoms, fans, mesas, and plateaus from eolian, alluvial, and residual materials derived from sandstone, shale, and siltstone.	Sheppard Huerfano Notal	60+ 10-20 60+	2-8 0-3 0-2	>6 >6 >6	7.9-8.4 7.9-9.0 7.9-9.0	<2 >4 4-8	A D D	2 4L 4L	.15 .32 .32	5 1 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is fair to poor, 8 inch precipitation zone. Shrink-swell potential is low to high, exchangeable sodium content ranges from 15-75% for Huerfano-Notal portion, high corrosion hazard to uncoated steel.
43.9-44.7	BT	Blancot-Notal: Deep, well drained, loam, clay loam, silty clay loam, and clay soils formed on level to gently sloping alluvial fans and upland valleys from alluvium derived primarily from sandstone and shale.	Blancot Notal	60+ 60+	0-5 0-2	>6 >6	7.9-8.4 7.9-9.0	<2 4-8	B D	6 4L	.32 .32	5 5	Low to moderate wind erosion hazard, moderate water erosion hazard, topsoil is fair to poor (too clayey), 8 inch precipitation zone. Shrink-swell potential is low to high, high corrosion hazard to uncoated steel.
44.7-45.1	SC	Sheppard-Huerfano-Notal: Deep and shallow, somewhat excessively and well drained, loamy fine sand, fine sand, sandy clay loam, clay loam, and clay soils formed on level to moderately sloping valley bottoms, fans, mesas, and plateaus from eolian, alluvial, and residual materials derived from sandstone, shale, and siltstone.	Sheppard Huerfano Notal	60+ 10-20 60+	2-8 0-3 0-2	>6 >6 >6	7.9-8.4 7.9-9.0 7.9-9.0	<2 >4 4-8	A D D	2 4L 4L	.15 .32 .32	5 1 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is fair to poor, 8 inch precipitation zone. Shrink-swell potential is low to high, exchangeable sodium content ranges from 15-75% for Huerfano-Notal portion, high corrosion hazard to uncoated steel.
45.1-45.85	BA	Badland: Moderately sloping to extremely steep, nonstony, barren shale uplands that are dissected by deep intermittent drainageways and gullies.	Badland	0	5-80	NA	NA	NA	NA	NA	NA	NA	8 inch precipitation zone.
45.85-48.5	SC	Sheppard-Huerfano-Notal: Deep and shallow, somewhat excessively and well drained, loamy fine sand, fine sand, sandy clay loam, clay loam, and clay soils formed on level to moderately sloping valley bottoms, fans, mesas, and plateaus from eolian, alluvial, and residual materials derived from sandstone, shale, and siltstone.	Sheppard Huerfano Notal	60+ 10-20 60+	2-8 0-3 0-2	>6 >6 >6	7.9-8.4 7.9-9.0 7.9-9.0	<2 >4 4-8	A D D	2 4L 4L	.15 .32 .32	5 1 5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is fair to poor, 8 inch precipitation zone. Shrink-swell potential is low to high, exchangeable sodium content ranges from 15-75% for Huerfano-Notal portion, high corrosion hazard to uncoated steel.

NA = Not available or not applicable.

[1] Source: U.S. Soil Conservation Service (SCS). 1980. Soil survey of San Juan County, New Mexico, eastern part.

and gullies. The terrain slopes range mainly from nearly level to strongly sloping, but a strongly sloping to steep Badland area would be traversed near the southern end of Kutz Canyon (between MP 13.7-16.0). Approximately 5.6 miles of Badland (nonstony, barren shale) would be traversed by pipeline route P3. Topsoil availability along this alternative pipeline route is limited due to generally shallow surface layers, and the majority of the existing topsoil is of fair to poor quality due to undesirable surface textures (e.g., too sandy or clayey) or excess salt/sodium. The Blackston (MP 0.25-0.30) and Persayo (map units FX and FA in Table 4) soils identified along this route are difficult to reclaim if the topsoil is removed and not replaced. Susceptibility of the identified soils to wind-induced soil erosion ranges from low to high, but it is primarily moderate to high. Susceptibility to water-induced soil erosion is primarily low to moderate. The soils identified along this alternative pipeline route are mildly to strongly alkaline. Shrink-swell potential of the identified soils is primarily low to moderate, but the Notal soil has a high shrink-swell potential. These soils are currently used primarily for livestock grazing, wildlife habitat, and energy resource development.

Proposed Terminal Storage Reservoir (R1). Three different soil associations (or land types) were identified at the proposed terminal storage reservoir site. Table 5 lists and characterizes the identified soils.

The soils identified at the R1 reservoir site are shallow to deep and well to somewhat excessively drained. Surface textures range from fine sand to clay loam. These soils are forming in alluvial, eolian, and residual materials derived primarily from shale, sandstone, and siltstone on a nearly level to moderately sloping mesa. More than 50 percent of the proposed reservoir site is Badland (nonstony, barren

Table 5. CHARACTERISTICS OF THE SOILS IDENTIFIED AT THE PROPOSED TERMINAL STORAGE RESERVOIR

Soil Association and Description[1]	Approximate Acreage	Soil Series	Depth to Bedrock (inches)	Slope (%)	Depth to High Water Table (feet)	Soil Reaction (pH)	Salinity (mmhos/cm)	Hydrologic Group	WEG Class	'K'	'T'	Comments
Badland: Moderately sloping to extremely steep, nonstony, barren shale uplands that are dissected by deep intermittent drainageways and gullies.	75	Badland	0	5-80	>6	NA	NA	D	NA	NA	NA	8 inch precipitation zone, potential runoff is very rapid, slight limitations for embankments, dikes, and levees.
Sheppard-Huerfano-Notal: Deep and shallow, somewhat excessively and well drained, loamy fine sand, fine sand, sandy clay loam, clay loam, and clay soils formed on level to moderately sloping valley bottoms, fans, mesas, and plateaus from eolian, alluvial, and residual materials derived from sandstone, shale, and siltstone.	35	Sheppard	60+	2-8	>6	7.9-8.4	<2	A	2	.15	5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is fair to poor, 8 inch precipitation zone. Shrink-swell potential is low to high, limitations for reservoirs, embankments, dikes, and levees are seepage and piping.
		Huerfano	10-20	0-3	>6	7.9-9.0	>4	D	4L	.32	1	
		Notal	60+	0-2	>6	7.9-9.0	4-8	D	4L	.32	5	
Huerfano-Muff-Uffens: Shallow to deep, well drained, sandy clay loam, clay loam, very fine sandy loam, and fine sandy loam soils formed on level to moderately sloping mesas and valleys from alluvium and residuum derived primarily from shale and siltstone.	35	Huerfano	10-20	0-3	>6	7.9-9.0	>4	D	4L	.32	1	Moderate wind and water erosion hazard, topsoil is poor due to shallowness, excess salt/sodium (Muff portion-area reclaim), 8 inch precipitation zone. Shrink-swell potential is low to moderate, limitations for reservoirs are minimal, limitations for
		Muff	20-40	0-8	>6	7.4-8.4	2-4	D	3	.28	3	
		Uffens	60+	0-5	>6	7.4-8.4	4-8	D	3	.20	1	
(Total Acreage)	(145)											

NA = Not available or not applicable.

[1] Sources:
(1) U.S. Soil Conservation Service (SCS). 1980. Soil survey of San Juan County, New Mexico, eastern part.
(2) SCS Form 5 - Soil Interpretation Table (Badland only).

shale). Topsoil availability at the site is limited due to shallow or nonexistent soil surface layers, and the majority of the existing topsoil is of fair to poor quality due to undesirable surface textures (e.g., too sandy or clayey) or excess salt/sodium. The Muff soil is difficult to reclaim if the topsoil is removed and not replaced. The identified soils are characterized by a moderate to high wind erosion hazard and a low to moderate water erosion hazard. These soils are mildly to strongly alkaline. Shrink-swell potential of the identified soils is primarily low to moderate, but the Notal soil has a high shrink-swell potential. The identified soils present slight to moderate limitations for reservoirs, embankments, dikes, and levees (e.g., shallowness, piping, and seepage). These soils are currently used primarily for livestock grazing and wildlife habitat.

Terminal Storage Reservoir Alternative (R2). Two different soil associations (SCS 1980) were identified at the alternative reservoir site. Map unit HU (Huerfano-Muff-Uffens) covers approximately 95 percent of the site, and map unit DN (Doak-Avalon) covers approximately 5 percent on the northern tip of the site.

The soils in map unit HU are shallow to deep, while map unit DN consists of deep soils. All of these soils are well drained, and the surface textures range from very fine sandy loam to clay loam. These soils are forming primarily in alluvium and residuum derived from shale and siltstone on a gently to moderately sloping upland drainage sideslope. The Avalon portion of map unit DN is also forming in eolian materials derived from sandstone and shale. Topsoil availability at the alternative reservoir site is limited due to generally shallow surface layers, and the majority of the existing topsoil is of poor to fair quality due to undesirable surface texture (too clayey) or excess salt/sodium. The Muff soil is difficult to reclaim if the topsoil is removed and not replaced. The identified soils are characterized by a moderate wind erosion hazard, and a primarily moderate water erosion hazard. These soils are mildly to strongly alkaline. The Avalon soil is moderately to highly susceptible to water-induced soil erosion. Since the Avalon soil covers a very small portion of the site (less than 2 percent), no significant water erosion problems would be expected to occur. Shrink-swell potential of the identified soils is low to moderate. The soils identified at this alternative reservoir site present slight to moderate limitations for reservoirs, embankments, dikes, and levees (e.g., shallowness, low strength, piping, and seepage). These soils are currently used primarily for livestock grazing and wildlife habitat.

Transmission Lines

Proposed FC-A-P 500-kV Transmission Line Loop (T5). The corridor associated with this proposed transmission line loop falls within transmission corridor T4. See Table 9 (MP 0.0-5.0) for the applicable soils data.

First Proposed Transmission Corridor (T2). The first proposed transmission corridor is within the San Juan River Valley Mesas and Plateaus and the New Mexico and Arizona Plateaus and Mesas portions of the Western Range and Irrigated Region (SCS 1978a). Annual precipitation generally ranges from 6 to 17 inches along T2, but most of this corridor receives between 6 and 14 inches. Fourteen different soil associations were identified within this corridor. Table 6 lists (by mileposts) and characterizes the identified soils.

The soils identified within the transmission corridor T2 are very shallow to deep, with surface textures ranging from gravelly loamy sand to clay. Permeability of these soils is very slow to rapid.

Table 6. CHARACTERISTICS OF THE SOILS IDENTIFIED WITHIN THE FIRST PROPOSED TRANSMISSION CORRIDOR (T2)

Milepost	Map Symbol	Soil Association and Description	Soil Series	Depth to Bedrock (inches)	Slope (%)	Comments
San Juan County[1]						
0.0-0.75	8	Badland-Rock Outcrop-Monierco: Shallow, well drained, fine sandy loam soils formed on level to moderately sloping knolls, mesas, and plateaus from alluvial and eolian materials derived primarily from sandstone and shale. Includes nonstony, barren shale areas on moderately sloping to extremely steep uplands that are dissected by deep intermittent drainageways and gullies; and barren sandstone outcrops on moderately sloping to extremely steep cliffs, ridges, breaks, and ledges.	Monierco	10-20	0-8	Moderate wind and water erosion hazard, poor topsoil, 6-10 inch precipitation zone. Shrink-swell potential is low to moderate, mild to moderately alkaline soils.
0.75-4.25	6	Sheppard-Huerfano-Notal: Deep to shallow, well to somewhat excessively drained, loamy fine sand, sandy clay loam, and silty clay loam soils formed on level to steep mesas, plateaus, valley bottoms and fans from eolian, alluvial, and residual materials derived from sandstone, shale, and siltstone.	Sheppard Huerfano Notal	60+ 10-20 60	0-40 0-3 0-2	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to fair, 6-10 inch precipitation zone. Shrink-swell potential is low to high, moderately to strongly alkaline soils.
4.25-5.0	6/8	Refer to Map Symbols - 6 and 8 (mileposts 0.75-4.25 and 0.0-0.75, respectively).				
5.0-5.75	6	Sheppard-Huerfano-Notal: Deep to shallow, well to somewhat excessively drained, loamy fine sand, sandy clay loam, and silty clay loam soils formed on level to steep mesas, plateaus, valley bottoms and fans from eolian, alluvial, and residual materials derived from sandstone, shale, and siltstone.	Sheppard Huerfano Notal	60+ 10-20 60	0-40 0-3 0-2	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to fair, 6-10 inch precipitation zone. Shrink-swell potential is low to high, moderately to strongly alkaline soils.
5.75-8.75	6/8	Refer to Map Symbols - 6 and 8 (mileposts 0.75-4.25 and 0.0-0.75, respectively).				
8.75-10.0	6	Sheppard-Huerfano-Notal: Deep to shallow, well to somewhat excessively drained, loamy fine sand, sandy clay loam, and silty clay loam soils formed on level to steep mesas, plateaus, valley bottoms and fans from eolian, alluvial, and residual materials derived from sandstone, shale, and siltstone.	Sheppard Huerfano Notal	60+ 10-20 60	0-40 0-3 0-2	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to fair, 6-10 inch precipitation zone. Shrink-swell potential is low to high, moderately to strongly alkaline soils.
10.0-11.0	6/8	Refer to Map Symbols - 6 and 8 (mileposts 0.75-4.25 and 0.0-0.75, respectively).				
11.0-13.25	6	Sheppard-Huerfano-Notal: Deep to shallow, well to somewhat excessively drained, loamy fine sand, sandy clay loam, and silty clay loam soils formed on level to steep mesas, plateaus, valley bottoms and fans from eolian, alluvial, and residual materials derived from sandstone, shale, and siltstone.	Sheppard Huerfano Notal	60+ 10-20 60	0-40 0-3 0-2	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to fair, 6-10 inch precipitation zone. Shrink-swell potential is low to high, moderately to strongly alkaline soils.
13.25-14.75	6/8	Refer to Map Symbols - 6 and 8 (mileposts 0.75-4.25 and 0.0-0.75, respectively).				
14.75-17.25	6/5	Refer to Map Symbols - 6 and 5 (mileposts 0.75-4.25 and 17.25-21.0, respectively).				
17.25-21.0	5	Blancot-Notal: Deep, well to somewhat excessively drained, loam and silty clay loam soils formed on level to gently sloping fans, valley sides, and valley bottoms from alluvium derived primarily from sandstone and shale.	Blancot Notal	60 60	0-5 0-2	Low to moderate wind erosion hazard, moderate water erosion hazard, topsoil is poor to fair, 6-10 inch precipitation zone. Shrink-swell potential is low to high, moderately to strongly alkaline soils.
21.0-22.0	5/6	Refer to Map Symbols - 5 and 6 (mileposts 17.25-21.0 and 0.0-0.75, respectively).				
22.0-23.25	6	Sheppard-Huerfano-Notal: Deep to shallow, well to somewhat excessively drained, loamy fine sand, sandy clay loam, and silty clay loam soils formed on level to steep mesas, plateaus, valley bottoms and fans from eolian, alluvial, and residual materials derived from dstone, and s e.	Sheppard Huerfano Notal	60+ 10-20 60	0-40 0-3 0-2	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to fair, 6-10 inch precipitation zone. Shrink-swell potential is low to high, moderately to strongly alkaline soils.

Table 6. CHARACTERISTICS OF THE SOILS IDENTIFIED WITHIN THE FIRST PROPOSED TRANSMISSION CORRIDOR (T2) (continued)

Milepost	Map Symbol	Soil Association and Description	Soil Series	Depth to Bedrock (inches)	Slope (%)	Comments
San Juan County[1] (continued)						
23.25-24.75	6/8	Refer to Map Symbols - 6 and 8 (mileposts 0.75-4.25 and 0.0-0.75, respectively).				
24.75-30.25	6	Sheppard-Huerfano-Notal: Deep to shallow, well to somewhat excessively drained, loamy fine sand, sandy clay loam, and silty clay loam soils formed on level to steep mesas, plateaus, valley bottoms and fans from eolian, alluvial, and residual materials derived from sandstone, shale, and siltstone.	Sheppard Huerfano Notal	60+ 10-20 60	0-40 0-3 0-2	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to fair, 6-10 inch precipitation zone. Shrink-swell potential is low to high, moderately to strongly alkaline soils.
30.25-32.0	6/5	Refer to Map Symbols - 6 and 5 (mileposts 0.75-4.25 and 17.25-21.0, respectively).				
McKinley County[2]						
32.0-35.0	14	Persayo-Lohmiller: Very shallow to deep, silty clay loam, silt loam, and silty clay loam soils formed on level to moderately steep broad valleys, uplands, escarpments, and breaks from residuum and alluvium derived from shale and sandstone. Includes barren or nearly barren shale outcrop areas.	Persayo Lohmiller	6-20 60+	5-25 0-3	Moderate wind and water erosion hazard, topsoil is poor to fair, 10-17 inch precipitation zone. Shrink-swell potential is moderate, permeability is slow to very slow, calcareous.
35.0-35.75	6	Penistaja-Valent: Deep, fine sandy loam, very fine sandy loam, and loamy fine sand soils formed on nearly level to gently sloping uplands, and upland ridges from eolian, alluvial, and residual materials derived primarily from sandstone and shale. Includes moderately steep to steep sandstone and shale outcrops, and Slick-spots or alkali-affected areas.	Penistaja Valent	60 60+	3-5 1-5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is fair to poor, 10-17 inch precipitation zone. Shrink-swell potential is low to moderate, permeability is moderate to rapid, noncalcareous.
35.75-38.5	6/14	Refer to Map Symbols - 6 and 14 (mileposts 35.0-35.75 and 32.0-35.0, respectively).				
38.5-40.0	6/14/13	Refer to Map Symbols - 6, 14, and 13 (mileposts 35.0-35.75; 32.0-35.0; and 45.5-46.25, respectively).				
40.0-41.0	14	Persayo-Lohmiller: Very shallow to deep, silty clay loam, silt loam, and silty clay loam soils formed on level to moderately steep broad valleys, uplands, escarpments, and breaks from residuum and alluvium derived from shale and sandstone. Includes barren or nearly barren shale outcrop areas.	Persayo Lohmiller	6-20 60+	5-25 0-3	Moderate wind and water erosion hazard, topsoil is poor to fair, 10-17 inch precipitation zone. Shrink-swell potential is moderate, permeability is slow to very slow, calcareous.
41.0-42.75	14/13	Refer to Map Symbols - 14 and 13 (mileposts 32.0-35.0 and 45.5-46.25, respectively).				
42.75-45.5	14	Persayo-Lohmiller: Very shallow to deep, silty clay loam, silt loam, and silty clay loam soils formed on level to moderately steep broad valleys, uplands, escarpments, and breaks from residuum and alluvium derived from shale and sandstone. Includes barren or nearly barren shale outcrop areas.	Persayo Lohmiller	6-20 60+	5-25 0-3	Moderate wind and water erosion hazard, topsoil is poor to fair, 10-17 inch precipitation zone. Shrink-swell potential is moderate, permeability is slow to very slow, calcareous.
45.5-46.25	13	Hagerman-Travessilla: Moderately deep to very shallow, fine sandy loam, loam, and gravelly sandy loam soils formed on nearly level to moderately steep uplands, mesa tops, valley bottoms, and flood plains in residuum derived from sandstone and in eolian and alluvial sediments of mixed origin. Includes steep sandstone (and some shale) outcrops.	Hagerman Travessilla	20-40 4-20	1-5 3-25	Moderate to high wind erosion hazard, moderate water erosion hazard, topsoil is good to poor, 10-17 inch precipitation zone. Shrink-swell potential is low, permeability is moderate to rapid, noncalcareous to slightly calcareous.
46.25-46.5	14	Persayo-Lohmiller: Very shallow to deep, silty clay loam, silt loam, and silty clay loam soils formed on level to moderately steep broad valleys, uplands, escarpments, and breaks from residuum and alluvium derived from shale and sandstone. Includes barren or nearly barren shale outcrop areas.	Persayo Lohmiller	6-20 60+	5-25 0-3	Moderate wind and water erosion hazard, topsoil is poor to fair, 10-17 inch precipitation zone. Shrink-swell potential is moderate, permeability is slow to very slow, calcareous.

Table 6. CHARACTERISTICS OF THE SOILS IDENTIFIED WITHIN THE FIRST PROPOSED TRANSMISSION CORRIDOR (T2) (continued)

Milepost	Map Symbol	Soil Association and Description	Soil Series	Depth to Bedrock (inches)	Slope (%)	Comments
McKinley County[2] (continued)						
46.5-47.75	13	Hagerman-Travessilla: Moderately deep to very shallow, fine sandy loam, loam, and gravelly sandy loam soils formed on nearly level to moderately steep uplands, mesa tops, valley bottoms, and flood plains in residuum derived from sandstone and in eolian and alluvial sediments of mixed origin. Includes steep sandstone (and some shale) outcrops.	Hagerman Travessilla	20-40 4-20	1-5 3-25	Moderate to high wind erosion hazard, moderate water erosion hazard, topsoil is good to poor, 10-17 inch precipitation zone. Shrink-swell potential is low, permeability is moderate to rapid, noncalcareous to slightly calcareous.
47.75-49.5	14/13	Refer to Map Symbols - 14 and 13 (mileposts 32.0-35.0 and 45.5-46.25, respectively).				
49.5-52.0	14/15	Refer to Map Symbols - 14 and 15 (mileposts 32.0-35.0 and 53.0-53.5, respectively).				
52.0-53.0	13/15	Refer to Map Symbols - 13 and 15 (mileposts 45.5-46.25 and 53.0-53.5, respectively).				
53.0-53.5	15	Las Lucas-Litle-Persayo: Deep to very shallow, loam, clay, silty clay loam, and silt loam soils formed on nearly level to moderately sloping alluvial fans, valley sideslopes, uplands, ridges, and knolls from alluvial and residual materials derived primarily from shale. Includes interbedded shale and sandstone exposures on steep escarpments and breaks.	Las Lucas Litle Persayo	40-60 20-40 6-20	3-5 3-5 1-9	Low to moderate wind erosion hazard, moderate to high water erosion hazard, topsoil is fair to poor, 7-10 inch precipitation zone. Shrink-swell potential is moderate to high, slow to very slow permeability, calcareous.
53.5-55.75	15/14	Refer to Map Symbols - 15 and 14 (mileposts 53.0-53.5 and 32.0-35.0, respectively).				
55.75-57.5	15	Las Lucas-Litle-Persayo: Deep to very shallow, loam, clay, silty clay loam, and silt loam soils formed on nearly level to moderately sloping alluvial fans, valley sideslopes, uplands, ridges, and knolls from alluvial and residual materials derived primarily from shale. Includes interbedded shale and sandstone exposures on steep escarpments and breaks.	Las Lucas Litle Persayo	40-60 20-40 6-20	3-5 3-5 1-9	Low to moderate wind erosion hazard, moderate to high water erosion hazard, topsoil is fair to poor, 7-10 inch precipitation zone. Shrink-swell potential is moderate to high, slow to very slow permeability, calcareous.
Sandoval County[3] (Part I)						
57.5-59.75	2	Litle-Las Lucas: Shallow to deep, well drained, loam, clay loam, and silty clay loam soils formed on level to moderately steep uplands and low hills from eolian materials and shale.	Litle Las Lucas	14-24 40-72+	1-25 0-9	Low wind erosion hazard, moderate to high water erosion hazard, fair to good topsoil, 10-14 inch precipitation zone. Shrink-swell potential is moderate to high, mildly to moderately alkaline soils.
59.75-63.5	2/6	Refer to Map Symbols - 2 and 6 (mileposts 57.5-59.75 and 63.5-74.75, respectively).				
63.5-74.75	6	Travessilla-Persayo: Very shallow to shallow, well drained, sandy loam, loam, and silty clay loam soils formed on gently sloping to moderately steep mesas and breaks from materials derived primarily from sandstone and shale.	Travessilla Persayo	6-16 0-16	3-25 9-25	Moderate wind and water erosion hazard, poor to fair topsoil, 10-14 inch precipitation zone. Shrink-swell potential is low to high, moderately alkaline soils.
74.75-75.5	2	Litle-Las Lucas: Shallow to deep, well drained, loam, clay loam, and silty clay loam soils formed on level to moderately steep uplands and low hills from eolian materials and shale.	Litle Las Lucas	14-24 40-72+	1-25 0-9	Low wind erosion hazard, moderate to high water erosion hazard, fair to good topsoil, 10-14 inch precipitation zone. Shrink-swell potential is moderate to high, mildly to moderately alkaline soils.
75.5-76.25	1/2	Refer to Map Symbols - 1 and 2 (mileposts 76.25-76.5 and 57.5-59.75, respectively).				
76.25-76.5	1	Christianburg-Navajo: Deep, somewhat poorly and poorly drained, silty clay, and clay soils formed on level to gently sloping flood plains and terraces from alluvium. Includes Slickspots areas which are alkali-affected and susceptible to puddling.	Christianburg Navajo	60+ 60+	0-3 0-3	Low wind erosion hazard, moderate to high water erosion hazard, topsoil is poor, 10-14 inch precipitation zone. Shrink-swell potential is high, strongly alkaline soils.
76.5-77.0	1[3]/10[4]	Refer to Map Symbols - 1 and 10 (mileposts 76.25-76.5 and 77.0-82.75, respectively).				

Table 6. CHARACTERISTICS OF THE SOILS IDENTIFIED WITHIN THE FIRST PROPOSED TRANSMISSION CORRIDOR (T2) (concluded)

Milepost	Map Symbol	Soil Association and Description	Soil Series	Depth to Bedrock (inches)	Slope (%)	Comments
Sandoval County[4] (Part II)						
77.0–82.75	10	Persayo-Turley-Badland: Very shallow to deep, silty clay loam, and silt loam soils formed on level to moderately steep uplands, ridges, valley bottoms, and valley sides from residuum derived from shale and sandstone, and to a lesser extent from alluvium. Includes moderately to very steep barren shale outcrops.	Persayo Turley	6–18 60+	5–25 0–5	Moderate wind and water erosion hazard, topsoil is poor, 10–14 inch precipitation zone. Shrink-swell potential is moderate, permeability is slow, calcareous.
82.75–83.75	10;	Refer to Map Symbol - 10 (milepost 77.0–82.75).				
	14	Apache-Silver-Rockland: Shallow to deep, stony loam, stony fine sandy loam, and loam soils formed on level to strongly sloping old lava flows and basaltic mesas from materials of volcanic or basic igneous origin. Includes basalt outcrops on moderately sloping to steep lava flow fronts and sides of basalt capped mesas.	Apache Silver	10–20 60	0–10 0–5	Low wind erosion hazard, moderate water erosion hazard, topsoil is poor to good, 10–14 inch precipitation zone. Shrink-swell potential is low to high, permeability is slow to moderate, calcareous and noncalcareous soils.
83.75–86.75	11/14	Refer to Map Symbols - 11 and 14 (mileposts 86.75–92.5 and 82.75–83.75, respectively).				
86.75–92.5	11	Las Lucas-Litle-Persayo: Deep to very shallow, clay, loam, silty clay loam, and silt loam soils formed on nearly level to moderately sloping alluvial fans, valley side slopes, uplands, ridges, and knolls from materials derived from weathered shale. Includes steep to very steep shale and sandstone outcrops.	Las Lucas Litle Persayo	40–60 20–40 6–18	3–5 3–5 1–9	Low wind erosion hazard, moderate to high water erosion hazard, fair to poor topsoil, 10–14 inch precipitation zone. Shrink-swell potential is moderate to high, permeability is slow to very slow, calcareous.
92.5–94.25	11;	Refer to Map Symbol - 11 (milepost 86.75–92.5).				
	13	Travessilla-Persayo-Rockland: Very shallow to shallow, sandy loam, silty clay loam, and silt loam soils formed on gently sloping to moderately steep mesas, breaks, ridges, and knolls from sandstone and shale. Includes interbedded sandstone and shale outcrops on moderately steep to extremely steep escarpments and breaks.	Travessilla Persayo	8–20 3–25	3–25 3–25	Moderate wind and water erosion hazard, topsoil is poor, 10–14 inch precipitation zone. Shrink-swell potential is low to moderate, permeability is rapid to slow, slightly calcareous and calcareous soils.
94.25–98.25	11	Las Lucas-Litle-Persayo: Deep to very shallow, clay, loam, silty clay loam, and silt loam soils formed on nearly level to moderately sloping alluvial fans, valley side slopes, uplands, ridges, and knolls from materials derived from weathered shale. Includes steep to very steep shale and sandstone outcrops.	Las Lucas Litle Persayo	40–60 20–40 6–18	3–5 3–5 1–9	Low wind erosion hazard, moderate to high water erosion hazard, fair to poor topsoil, 10–14 inch precipitation zone. Shrink-swell potential is moderate to high, permeability is slow to very slow, calcareous.
98.25–99.5	7/11	Refer to Map Symbols - 7 and 11 (mileposts 99.5–101.0 and 86.75–92.5, respectively).				
99.5–101.0	7	Rough Broken Land-Bubudo: Shallow to moderately deep, gravelly fine sandy loam, fine sandy loam, gravelly sandy loam, and gravelly loamy sand soils formed on nearly level to moderately steep uplands dissected by numerous intermittent drainages and arroyos as well as breaks, ridges, and to a lesser extent valley bottoms and flood plains. These soils are forming primarily in unconsolidated alluvium.	Bubudo	20–36	1–9	Low wind erosion hazard, moderate water erosion hazard, topsoil is poor, 10–14 inch precipitation zone. Shrink-swell potential is low, permeability is rapid, calcareous.

Sources:

[1] U.S. Soil Conservation Service (SCS). 1979. General soil map, San Juan County, New Mexico, eastern part. Soil survey of San Juan County, New Mexico, eastern part.

[2] _________. 1974. General soil map of McKinley County, New Mexico. New Mexico State University, Agricultural Experiment Station, Research Report 262.

[3] _________. 1967. General soil map, Cabezon area, Sandoval County, New Mexico. Soil survey, Cabezon area, New Mexico.

[4] . 1971. General soil map of Sandoval and Los Alamos counties, New Mexico. New Mexico State University, Agricultural Experiment Station, Research Report 188.

These soils are forming primarily in alluvial, eolian, and residual materials derived from sandstone, shale, and siltstone, and to a lesser extent in materials of volcanic origin (e.g., basalt). These soils are forming primarily on gently to strongly sloping mesas, plateaus, hills, ridges, knolls, valleys, intermittent drainageways, and floodplains. This proposed transmission corridor traverses numerous intermittent drainages as well as Badland (nonstony, barren shale) and Rock Outcrop (barren sandstone and lava) areas. Topsoil availability within this proposed transmission corridor is limited due to generally shallow soil surface layers, and the majority of the existing topsoil is of fair to poor quality due to undesirable surface textures (e.g., too sandy or clayey) or excess salt/sodium. Susceptibility to wind-induced soil erosion ranges from low to high, and susceptibility to water-induced soil erosion also ranges from low to high. Most of the soils identified within this proposed transmission corridor are alkaline and/or calcareous. Shrink-swell potential of the identified soils ranges from low to high. These soils are used primarily for livestock grazing, wildlife habitat, and to a lesser extent energy resources development.

Second Proposed Transmission Corridor (Tl). The Tl transmission corridor is within the San Juan River Mesas and Plateaus and the New Mexico and Arizona Plateaus and Mesas portions of the Western Range and Irrigated Region (SCS 1978a). Annual precipitation generally ranges from 6 to 17 inches along this proposed transmission corridor, but most of this corridor receives between 6 and 14 inches. Eighteen different soil associations were identified within this proposed transmission corridor. Table 7 lists (by mileposts) and characterizes the identified soils.

The soils identified within the transmission corridor Tl are very shallow to deep, with surface textures ranging from gravelly loamy

Table 7. CHARACTERISTICS OF THE SOILS IDENTIFIED WITHIN THE SECOND PROPOSED TRANSMISSION CORRIDOR (T1)

Milepost	Map Symbol	Soil Association and Description	Soil Series	Depth to Bedrock (inches)	Slope (%)	Comments
San Juan County[1]						
0.0–0.5	8	Badland-Rock Outcrop-Monierco: Shallow, well drained, fine sandy loam soils formed on level to moderately sloping knolls, mesas, and plateaus from alluvial and eolian materials derived primarily from sandstone and shale. Includes nonstony, barren shale areas on moderately sloping to extremely steep uplands that are dissected by deep intermittent drainageways and gullies; and barren sandstone outcrops on moderately sloping to extremely steep cliffs, ridges, breaks, and ledges.	Monierco	10–20	0–8	Moderate wind and water erosion hazard, poor topsoil, 6–10 inch precipitation zone. Shrink-swell potential is low to moderate, mild to moderately alkaline soils.
0.5–11.5	6	Sheppard-Huerfano-Notal: Deep to shallow, well to somewhat excessively drained, loamy fine sand, sandy clay loam, and silty clay loam soils formed on level to steep mesas, plateaus, valley bottoms and fans from eolian, alluvial, and residual materials derived from sandstone, shale, and siltstone.	Sheppard Huerfano Notal	60+ 10–20 60	0–40 0–3 0–2	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to fair, 6–10 inch precipitation zone. Shrink-swell potential is low to high, moderately to strongly alkaline soils.
11.5–13.25	3	Shiprock-Sheppard-Doak: Deep, well to somewhat excessively drained, fine sandy loam, loamy fine sand, and loam soils formed on level to moderately steep mesas, plateaus, and terraces from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Shiprock Sheppard Doak	60 60+ 60+	0–8 0–30 0–5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is fair to good, 6–10 inch precipitation zone. Shrink-swell potential is low to moderate, mildly to moderately alkaline soils.
13.25–15.5	3/8	Refer to Map Symbols – 3 and 8 (mileposts 11.5–13.25 and 0.0–0.5, respectively).				
15.5–18.5	6	Sheppard-Huerfano-Notal: Deep to shallow, well to somewhat excessively drained, loamy fine sand, sandy clay loam, and silty clay loam soils formed on level to steep mesas, plateaus, valley bottoms and fans from eolian, alluvial, and residual materials derived from sandstone, shale, and siltstone.	Sheppard Huerfano Notal	60+ 10–20 60	0–40 0–3 0–2	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to fair, 6–10 inch precipitation zone. Shrink-swell potential is low to high, moderately to strongly alkaline soils.
18.5–19.5	6;	Refer to Map Symbol – 6 (milepost 0.5–11.5).				
	1	Persayo-Fruitland-Sheppard: Very shallow to deep, well to excessively drained, clay loam, sandy loam, and loamy fine sand soils formed on level to steep hills, breaks, valley sides, fans, and plateaus from alluvial, residual, and eolian materials derived from shale, sandstone, and mixed sources.	Persayo Fruitland Sheppard	10–20 60 60+	3–40 0–30 0–40	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to fair, 6–10 inch precipitation zone. Shrink-swell potential is low to moderate, mildly to strongly alkaline soils.
19.5–21.0	1	Persayo-Fruitland-Sheppard: Very shallow to deep, well to excessively drained, clay loam, sandy loam, and loamy fine sand soils formed on level to steep hills, breaks, valley sides, fans, and plateaus from alluvial, residual, and eolian materials derived from shale, sandstone, and mixed sources.	Persayo Fruitland Sheppard	10–20 60 60+	3–40 0–30 0–40	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to fair, 6–10 inch precipitation zone. Shrink-swell potential is low to moderate, mildly to strongly alkaline soils.
21.0–22.25	5	Blancot-Notal: Deep, well to somewhat excessively drained, loam and silty clay loam soils formed on level to gently sloping fans, valley sides, and valley bottoms from alluvium derived primarily from sandstone and shale.	Blancot Notal	60 60	0–5 0–2	Low to moderate wind erosion hazard, moderate water erosion hazard, topsoil is poor to fair, 6–10 inch precipitation zone. Shrink-swell potential is low to high, moderately to strongly alkaline soils.
22.25–22.75	5/1	Refer to Map Symbols – 5 and 1 (mileposts 21.0–22.25 and 19.5–21.0, respectively).				

Table 7. CHARACTERISTICS OF THE SOILS IDENTIFIED WITHIN THE SECOND PROPOSED TRANSMISSION CORRIDOR (T1) (continued)

Milepost	Map Symbol	Soil Association and Description	Soil Series	Depth to Bedrock (inches)	Slope (%)	Comments
San Juan County[1] (continued)						
22.75-23.5	5	Blancot-Notal: Deep, well to somewhat excessively drained, loam and silty clay loam soils formed on level to gently sloping fans, valley sides, and valley bottoms from alluvium derived primarily from sandstone and shale.	Blancot Notal	60 60	0-5 0-2	Low to moderate wind erosion hazard, moderate water erosion hazard, topsoil is poor to fair, 6-10 inch precipitation zone. Shrink-swell potential is low to high, moderately to strongly alkaline soils.
23.5-25.5	1	Persayo-Fruitland-Sheppard: Very shallow to deep, well to excessively drained, clay loam, sandy loam, and loamy fine sand soils formed on level to steep hills, breaks, valley sides, fans, and plateaus from alluvial, residual, and eolian materials derived from shale, sandstone, and mixed sources.	Persayo Fruitland Sheppard	10-20 60 60+	3-40 0-30 0-40	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to fair, 6-10 inch precipitation zone. Shrink-swell potential is low to moderate, mildly to strongly alkaline soils.
25.5-26.75	3/1	Refer to Map Symbols - 3 and 1 (mileposts 11.5-13.25 and 18.5-19.5, respectively).				
26.75-28.0	1	Persayo-Fruitland-Sheppard: Very shallow to deep, well to excessively drained, clay loam, sandy loam, and loamy fine sand soils formed on level to steep hills, breaks, valley sides, fans, and plateaus from alluvial, residual, and eolian materials derived from shale, sandstone, and mixed sources.	Persayo Fruitland Sheppard	10-20 60 60+	3-40 0-30 0-40	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to fair, 6-10 inch precipitation zone. Shrink-swell potential is low to moderate, mildly to strongly alkaline soils.
28.0-29.5	1/5	Refer to Map Symbols - 1 and 5 (mileposts 18.5-19.5 and 21.0-22.5, respectively).				
29.5-30.0	1/3	Refer to Map Symbols - 1 and 3 (mileposts 18.5-19.5 and 11.5-13.25, respectively).				
30.0-31.5	3	Shiprock-Sheppard-Doak: Deep, well to somewhat excessively drained, fine sandy loam, loamy fine sand, and loam soils formed on level to moderately steep mesas, plateaus, and terraces from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Shiprock Sheppard Doak	60 60+ 60+	0-8 0-30 0-5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is fair to good, 6-10 inch precipitation zone. Shrink-swell potential is low to moderate, mildly to moderately alkaline soils.
31.5-33.5	5	Blancot-Notal: Deep, well to somewhat excessively drained, loam and silty clay loam soils formed on level to gently sloping fans, valley sides, and valley bottoms from alluvium derived primarily from sandstone and shale.	Blancot Notal	60 60	0-5 0-2	Low to moderate wind erosion hazard, moderate water erosion hazard, topsoil is poor to fair, 6-10 inch precipitation zone. Shrink-swell potential is low to high, moderately to strongly alkaline soils.
Sandoval County[2] (Part I)						
33.5-34.5	10	Persayo-Turley-Badland: Very shallow to deep, silty clay loam, and silt loam soils formed on level to moderately steep uplands, ridges, valley bottoms, and valley sides from residuum derived from shale and sandstone, and to a lesser extent from alluvium. Includes moderately to very steep barren shale outcrops.	Persayo Turley	6-18 60+	5-25 0-5	Moderate wind and water erosion hazard, topsoil is poor, 10-14 inch precipitation zone. Shrink-swell potential is moderate, permeability is slow, calcareous.
34.5-36.75	8	Penistaja-Valent-Rockland: Deep, fine sandy loam, very fine sandy loam, and loamy fine sand soils formed on nearly level to gently sloping uplands from eolian and alluvial deposits and to a lesser extent from residual materials derived from sandstone and other sedimentary rocks. Includes moderately sloping to moderately steep outcrops of sandstone and shale, and associated rough lands.	Penistaja Valent	60 60+	3-5 1-5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is fair to poor, 10-14 inch precipitation zone. Shrink-swell potential is low to moderate, permeability is moderate to rapid, noncalcareous.
36.75-37.75	8/10	Refer to Map Symbols - 8 and 10 (mileposts 34.5-36.75 and 33.5-34.5, respectively).				

Table 7. CHARACTERISTICS OF THE SOILS IDENTIFIED WITHIN THE SECOND PROPOSED TRANSMISSION CORRIDOR (T1) (continued)

Milepost	Map Symbol	Soil Association and Description	Soil Series	Depth to Bedrock (inches)	Slope (%)	Comments
Sandoval County[2] (Part I) (continued)						
37.75-41.0	8	Penistaja-Valent-Rockland: Deep, fine sandy loam, very fine sandy loam, and loamy fine sand soils formed on nearly level to gently sloping uplands from eolian and alluvial deposits and to a lesser extent from residual materials derived from sandstone and other sedimentary rocks. Includes moderately sloping to moderately steep outcrops of sandstone and shale, and associated rough lands.	Penistaja Valent	60 60+	3-5 1-5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is fair to poor, 10-14 inch precipitation zone. Shrink-swell potential is low to moderate, permeability is moderate to rapid, noncalcareous.
41.0-45.5	10	Persayo-Turley-Badland: Very shallow to deep, silty clay loam, and silt loam soils formed on level to moderately steep uplands, ridges, valley bottoms, and valley sides from residuum derived from shale and sandstone, and to a lesser extent from alluvium. Includes moderately to very steep barren shale outcrops.	Persayo Turley	6-18 60+	5-25 0-5	Moderate wind and water erosion hazard, topsoil is poor, 10-14 inch precipitation zone. Shrink-swell potential is moderate, permeability is slow, calcareous.
45.5-46.75	10/8	Refer to Map Symbols - 10 and 8 (mileposts 33.5-34.5 and 34.5-36.75, respectively).				
46.75-50.75	8	Penistaja-Valent-Rockland: Deep, fine sandy loam, very fine sandy loam, and loamy fine sand soils formed on nearly level to gently sloping uplands from eolian and alluvial deposits and to a lesser extent from residual materials derived from sandstone and other sedimentary rocks. Includes moderately sloping to moderately steep outcrops of sandstone and shale, and associated rough lands.	Penistaja Valent	60 60+	3-5 1-5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is fair to poor, 10-14 inch precipitation zone. Shrink-swell potential is low to moderate, permeability is moderate to rapid, noncalcareous.
McKinley County[3]						
50.75-56.5	6	Penistaja-Valent: Deep, fine sandy loam, very fine sandy loam, and loamy fine sand soils formed on nearly level to gently sloping uplands, and upland ridges from eolian, alluvial, and residual materials derived primarily from sandstone and shale. Includes moderately steep to steep sandstone and shale outcrops, and Slickspots or alkali-affected areas.	Penistaja Valent	60 60+	3-5 1-5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is fair to poor, 10-17 inch precipitation zone. Shrink-swell potential is low to moderate, permeability is moderate to rapid, noncalcareous.
56.5-57.25	14	Persayo-Lohmiller: Very shallow to deep, silty clay loam, silt loam, and silty clay loam soils formed on level to moderately steep broad valleys, uplands, escarpments, and breaks from residuum and alluvium derived from shale and sandstone. Includes barren or nearly barren shale outcrop areas.	Persayo Lohmiller	6-20 60+	5-25 0-3	Moderate wind and water erosion hazard, topsoil is poor to fair, 10-17 inch precipitation zone. Shrink-swell potential is moderate, permeability is slow to very slow, calcareous.
Sandoval County[2,4] (Part II)						
57.25-64.75	3	Penistaja-Berent-Sandstone Outcrop: Deep and moderately deep, well to excessively drained, fine sandy loam, and loamy fine sand soils formed on level to moderately sloping uplands, mesas, and ridges from eolian materials and to a lesser extent from alluvium. Includes strongly sloping to moderately steep sandstone outcrops and Slickspots areas (alkali-affected).	Penistaja Berent	60+ 36-60	0-9 0-9	Moderate to high wind erosion hazard, moderate water erosion hazard, topsoil is good to poor, 10-14 inch precipitation zone. Shrink-swell potential is low to moderate, mildly to moderately alkaline soils.
64.75-69.75	2	Litle-Las Lucas: Shallow to deep, well drained, loam, clay loam, and silty clay loam soils formed on level to moderately steep uplands and low hills from eolian materials and shale.	Litle Las Lucas	14-24 40-72+	1-25 0-9	Low wind erosion hazard, moderate to high water erosion hazard, fair to good topsoil, 10-14 inch precipitation zone. Shrink-swell potential is moderate to high, mildly to moderately alkaline soils.

Table 7. CHARACTERISTICS OF THE SOILS IDENTIFIED WITHIN THE SECOND PROPOSED TRANSMISSION CORRIDOR (T1) (continued)

Milepost	Map Symbol	Soil Association and Description	Soil Series	Depth to Bedrock (inches)	Slope (%)	Comments
Sandoval County[2,4] (Part II) (continued)						
69.75-79.75	6	Travessilla-Persayo: Very shallow to shallow, well drained, sandy loam, loam, and silty clay loam soils formed on gently sloping to moderately steep mesas and breaks from materials derived primarily from sandstone and shale.	Travessilla Persayo	6-16 0-16	3-25 9-25	Moderate wind and water erosion hazard, poor to fair topsoil, 10-14 inch precipitation zone. Shrink-swell potential is low to high, moderately alkaline soils.
79.75-80.5	2/6	Refer to Map Symbols - 2 and 6 (mileposts 64.75-69.75 and 69.75-79.75, respectively).				
80.5-81.0	1	Christianburg-Navajo: Deep, somewhat poorly and poorly drained, silty clay, and clay soils formed on level to gently sloping flood plains and terraces from alluvium. Includes Slickspots areas which are alkali-affected and susceptible to puddling.	Christianburg Navajo	60+ 60+	0-3 0-3	Low wind erosion hazard, moderate to high water erosion hazard, topsoil is poor, 10-14 inch precipitation zone. Shrink-swell potential is high, strongly alkaline soils.
81.0-81.5	11	Las Lucas-Litle-Persayo: Deep to very shallow, clay, loam, silty clay loam, and silt loam soils formed on nearly level to moderately sloping alluvial fans, valley side slopes, uplands, ridges, and knolls from materials derived from weathered shale. Includes steep to very steep shale and sandstone outcrops.	Las Lucas Litle Persayo	40-60 20-40 6-18	3-5 3-5 1-9	Low wind erosion hazard, moderate to high water erosion hazard, fair to poor topsoil, 10-14 inch precipitation zone. Shrink-swell potential is moderate to high, permeability is slow to very slow, calcareous.
81.5-82.5	11/10	Refer to Map Symbols - 11 and 10 (mileposts 81.0-81.5 and 33.5-34.5, respectively).				
82.5-85.0	10	Persayo-Turley-Badland: Very shallow to deep, silty clay loam, and silt loam soils formed on level to moderately steep uplands, ridges, valley bottoms, and valley sides from residuum derived from shale and sandstone, and to a lesser extent from alluvium. Includes moderately to very steep barren shale outcrops.	Persayo Turley	6-18 60+	5-25 0-5	Moderate wind and water erosion hazard, topsoil is poor, 10-14 inch precipitation zone. Shrink-swell potential is moderate, permeability is slow, calcareous.
85.0-86.0	10/11	Refer to Map Symbols - 10 and 11 (mileposts 33.5-34.5 and 81.0-81.5, respectively).				
86.0-91.0	11	Las Lucas-Litle-Persayo: Deep to very shallow, clay, loam, silty clay loam, and silt loam soils formed on nearly level to moderately sloping alluvial fans, valley side slopes, uplands, ridges, and knolls from materials derived from weathered shale. Includes steep to very steep shale and sandstone outcrops.	Las Lucas Litle Persayo	40-60 20-40 6-18	3-5 3-5 1-9	Low wind erosion hazard, moderate to high water erosion hazard, fair to poor topsoil, 10-14 inch precipitation zone. Shrink-swell potential is moderate to high, permeability is slow to very slow, calcareous.
91.0-92.0	11/13	Refer to Map Symbols - 11 and 13 (mileposts 81.0-81.5 and 92.0-94.0, respectively).				
92.0-94.0	13	Travessilla-Persayo-Rockland: Very shallow to shallow, sandy loam, silty clay loam, and silt loam soils formed on gently sloping to moderately steep mesas, breaks, ridges, and knolls from sandstone and shale. Includes interbedded sandstone and shale outcrops on moderately steep to extremely steep escarpments and breaks.	Travessilla Persayo	8-20 3-25	3-25 3-25	Moderate wind and water erosion hazard, topsoil is poor, 10-14 inch precipitation zone. Shrink-swell potential is low to moderate, permeability is rapid to slow, slightly calcareous and calcareous soils.
94.0-96.25	13/11	Refer to Map Symbols - 13 and 11 (mileposts 92.0-94.0 and 81.0-81.5, respectively).				
96.25-100.0	11	Las Lucas-Litle-Persayo: Deep to very shallow, clay, loam, silty clay loam, and silt loam soils formed on nearly level to moderately sloping alluvial fans, valley side slopes, uplands, ridges, and knolls from materials derived from weathered shale. Includes steep to very steep shale and sandstone outcrops.	Las Lucas Litle Persayo	40-60 20-40 6-18	3-5 3-5 1-9	Low wind erosion hazard, moderate to high water erosion hazard, fair to poor topsoil, 10-14 inch precipitation zone. Shrink-swell potential is moderate to high, permeability is slow to very slow, calcareous.

Table 7. CHARACTERISTICS OF THE SOILS IDENTIFIED WITHIN THE SECOND PROPOSED TRANSMISSION CORRIDOR (T1) (concluded)

Milepost	Map Symbol	Soil Association and Description	Soil Series	Depth to Bedrock (inches)	Slope (%)	Comments
Sandoval County[4] (Part II) (continued)						
100.0-102.75	11;	Refer to Map Symbol - 11 (milepost 81.0-81.5).				
	7	Rough Broken Land-Embudo: Shallow to moderately deep, gravelly fine sandy loam, fine sandy loam, gravelly sandy loam, and gravelly loamy sand soils formed on nearly level to moderately steep uplands dissected by numerous intermittent drainages and arroyos as well as breaks, ridges, and to a lesser extent valley bottoms and flood plains. These soils are forming primarily in unconsolidated alluvium.	Embudo	20-36	1-9	Low wind erosion hazard, moderate water erosion hazard, topsoil is poor, 10-14 inch precipitation zone. Shrink-swell potential is low, permeability is rapid, calcareous.
102.75-104.25	7/5	Refer to Map Symbols - 7 and 5 (mileposts 100.0-102.75 and 104.25-108.0, respectively).				
104.25-108.0	5	Madurez-Caliza-Wink: Shallow to moderately deep, loamy fine sand, fine sandy loam, gravelly sandy loam, and very gravelly sandy loam soils formed on nearly level to moderately sloping uplands and ridges from unconsolidated alluvium.	Madurez Caliza Wink	20-36 10-20 20-36	1-3 1-9 1-9	Moderate to high wind erosion hazard, low to moderate water erosion hazard, poor topsoil, 10-14 inch precipitation zone. Shrink-swell potential is low to moderate, permeability is moderate to rapid, noncalcareous and calcareous soils.

Sources:

[1] U.S. Soil Conservation Service (SCS). 1979. General soil map, San Juan County, New Mexico, eastern part. Soil survey of San Juan County, New Mexico, eastern part.

[2] ________. 1971. General soil map of Sandoval and Los Alamos counties, New Mexico. New Mexico State University, Agricultural Experiment Station, Research Report 188.

[3] ________. 1974. General soil map of McKinley County, New Mexico. New Mexico State University, Agricultural Experiment Station, Research Report 262.

[4] ________. 1967. General soil map, Cabezon area, Sandoval County, New Mexico. Soil survey, Cabezon area, New Mexico.

sand to clay loam. Permeability of these soils is very slow to rapid. These soils are forming in alluvial, eolian, and residual materials derived primarily from sandstone, shale, and siltstone. These soils are forming primarily on gently sloping to strongly sloping mesas, plateaus, hills, ridges, knolls, valleys, intermittent drainageways, and floodplains. This proposed transmission corridor traverses numerous intermittent drainages, as well as Badland (nonstony, barren shale) and Rock Outcrop (barren sandstone) areas. Topsoil availability within this proposed transmission corridor is limited due to generally shallow soil surface layers, and the majority of the existing topsoil is of fair to poor quality due to undesirable surface textures (e.g., too sandy, clayey, or gravelly) or excess salt/sodium. Susceptibility to wind-induced soil erosion ranges from low to high, and susceptibility to water-induced soil erosion also ranges from low to high. Most of the soils identified within this proposed transmission corridor are alkaline and/or calcareous. Shrink-swell potential of the identified soils ranges from low to high. These soils are used primarily for livestock grazing, wildlife habitat, and to a lesser extent energy resource development.

Transmission Corridor T3. Alternative transmission corridor T3 is within the San Juan River Valley Mesas and Plateaus and the New Mexico and Arizona Plateaus and Mesas portions of the Western Range and Irrigated Region (SCS 1978a). Annual precipitation generally ranges from 6 to 17 inches along this transmission corridor alternative. Seventeen different soil associations were identified within this corridor alternative. Table 8 lists (by mileposts) and characterizes the identified soils.

The soils identified within transmission corridor T3 are very shallow to deep, with surface textures ranging from loamy fine sand to clay. Permeability of these soils is very slow to rapid. These soils

Table 8. CHARACTERISTICS OF THE SOILS IDENTIFIED WITHIN THE TRANSMISSION CORRIDOR ALTERNATIVE T3.

Milepost	Map Symbol	Soil Association and Description	Soil Series	Depth to Bedrock (inches)	Slope (%)	Comments
San Juan County[1]						
0.0-0.75	8	Badland-Rock Outcrop-Monierco: Shallow, well drained, fine sandy loam soils formed on level to moderately sloping knolls, mesas, and plateaus from alluvial and eolian materials derived primarily from sandstone and shale. Includes nonstony, barren shale areas on moderately sloping to extremely steep uplands that are dissected by deep intermittent drainageways and gullies; and barren sandstone outcrops on moderately sloping to extremely steep cliffs, ridges, breaks, and ledges.	Monierco	10-20	0-8	Moderate wind and water erosion hazard, poor topsoil, 6-10 inch precipitation zone. Shrink-swell potential is low to moderate, mild to moderately alkaline soils.
0.75-1.25	6	Sheppard-Huerfano-Notal: Deep to shallow, well to somewhat excessively drained, loamy fine sand, sandy clay loam, and silty clay loam soils formed on level to steep mesas, plateaus, valley bottoms and fans from eolian, alluvial, and residual materials derived from sandstone, shale, and siltstone.	Sheppard Huerfano Notal	60+ 10-20 60	0-40 0-3 0-2	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to fair, 6-10 inch precipitation zone. Shrink-swell potential is low to high, moderately to strongly alkaline soils.
1.25-3.5	6;	Refer to Map Symbol - 6 (milepost 0.75-1.25).				
	3	Shiprock-Sheppard-Doak: Deep, well to somewhat excessively drained, fine sandy loam, loamy fine sand, and loam soils formed on level to moderately steep mesas, plateaus, and terraces from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Shiprock Sheppard Doak	60 60+ 60+	0-8 0-30 0-5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is fair to good, 6-10 inch precipitation zone. Shrink-swell potential is low to moderate, mildly to moderately alkaline soils.
3.5-4.0	6/8	Refer to Map Symbols - 6 and 8 (mileposts 0.75-1.25 and 0.0-0.75, respectively).				
4.0-5.5	6	Sheppard-Huerfano-Notal: Deep to shallow, well to somewhat excessively drained, loamy fine sand, sandy clay loam, and silty clay loam soils formed on level to steep mesas, plateaus, valley bottoms and fans from eolian, alluvial, and residual materials derived from sandstone, shale, and siltstone.	Sheppard Huerfano Notal	60+ 10-20 60	0-40 0-3 0-2	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to fair, 6-10 inch precipitation zone. Shrink-swell potential is low to high, moderately to strongly alkaline soils.
5.5-6.0	8	Badland-Rock Outcrop-Monierco: Shallow, well drained, fine sandy loam soils formed on level to moderately sloping knolls, mesas, and plateaus from alluvial and eolian materials derived primarily from sandstone and shale. Includes nonstony, barren shale areas on moderately sloping to extremely steep uplands that are dissected by deep intermittent drainageways and gullies; and barren sandstone outcrops on moderately sloping to extremely steep cliffs, ridges, breaks, and ledges.	Monierco	10-20	0-8	Moderate wind and water erosion hazard, poor topsoil, 6-10 inch precipitation zone. Shrink-swell potential is low to moderate, mild to moderately alkaline soils.
6.0-6.5	6/8	Refer to Map Symbols - 6 and 8 (mileposts 0.75-1.25 and 0.0-0.75, respectively).				
6.5-17.25	6	Sheppard-Huerfano-Notal: Deep to shallow, well to somewhat excessively drained, loamy fine sand, sandy clay loam, and silty clay loam soils formed on level to steep mesas, plateaus, valley bottoms and fans from eolian, alluvial, and residual materials derived from sandstone, shale, and siltstone.	Sheppard Huerfano Notal	60+ 10-20 60	0-40 0-3 0-2	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to fair, 6-10 inch precipitation zone. Shrink-swell potential is low to high, moderately to strongly alkaline soils.

Table 8. CHARACTERISTICS OF THE SOILS IDENTIFIED WITHIN THE 'N' TRANSMISSION CORRIDOR ALTERNATIVE (T3) (continued)

Milepost	Map Symbol	Soil Association and Description	Soil Series	Depth to Bedrock (inches)	Slope (%)	Comments
McKinley County[2]						
17.25-19.0	1/2	Refer to Map Symbols - 1 and 2 (mileposts 19.0-24.0 and 27.25-28.0).				
19.0-24.0	1	Persayo-Camborthids: Very shallow to moderately deep, silt loam, silty clay loam, and fine sandy loam soils formed on nearly level to strongly sloping uplands in residuum derived primarily from sandstone. Includes steep to extremely steep sandstone and interbedded shale outcrops.	Persayo Camborthids	6-20 20-36	1-15 1-8	Moderate to high wind erosion hazard, moderate water erosion hazard, poor topsoil, 10-17 inch precipitation zone. Shrink-swell potential is low to moderate, permeability is slow to moderate, calcareous.
24.0-25.75	2	Persayo-Billings: Very shallow to deep, silty clay loam soils formed on level to strongly sloping uplands, alluvial fans, valley sides, and flood plains in residuum and alluvium derived from shale.	Persayo Billings	6-20 60+	0-15 0-5	Moderate wind erosion hazard, low to high water erosion hazard, poor topsoil, 10-17 inch precipitation zone. Shrink-swell potential is moderate, permeability is very slow to slow, calcareous.
25.75-27.25	1	Persayo-Camborthids: Very shallow to moderately deep, silt loam, silty clay loam, and fine sandy loam soils formed on nearly level to strongly sloping uplands in residuum derived primarily from sandstone. Includes steep to extremely steep sandstone and interbedded shale outcrops.	Persayo Camborthids	6-20 20-36	1-15 1-8	Moderate to high wind erosion hazard, moderate water erosion hazard, poor topsoil, 10-17 inch precipitation zone. Shrink-swell potential is low to moderate, permeability is slow to moderate, calcareous.
27.25-28.0	2	Persayo-Billings: Very shallow to deep, silty clay loam soils formed on level to strongly sloping uplands, alluvial fans, valley sides, and flood plains in residuum and alluvium derived from shale.	Persayo Billings	6-20 60+	0-15 0-5	Moderate wind erosion hazard, low to high water erosion hazard, poor topsoil, 10-17 inch precipitation zone. Shrink-swell potential is moderate, permeability is very slow to slow, calcareous.
28.0-30.0	1	Persayo-Camborthids: Very shallow to moderately deep, silt loam, silty clay loam, and fine sandy loam soils formed on nearly level to strongly sloping uplands in residuum derived primarily from sandstone. Includes steep to extremely steep sandstone and interbedded shale outcrops.	Persayo Camborthids	6-20 20-36	1-15 1-8	Moderate to high wind erosion hazard, moderate water erosion hazard, poor topsoil, 10-17 inch precipitation zone. Shrink-swell potential is low to moderate, permeability is slow to moderate, calcareous.
30.0-32.0	13	Hagerman-Travessilla: Moderately deep to very shallow, fine sandy loam, loam, and gravelly sandy loam soils formed on nearly level to moderately steep uplands, mesa tops, valley bottoms, and flood plains in residuum derived from sandstone and in eolian and alluvial sediments of mixed origin. Includes steep sandstone (and some shale) outcrops.	Hagerman Travessilla	20-40 4-20	1-5 3-25	Moderate to high wind erosion hazard, moderate water erosion hazard, topsoil is good to poor, 10-17 inch precipitation zone. Shrink-swell potential is low, permeability is moderate to rapid, noncalcareous to slightly calcareous.
32.0-32.5	2	Persayo-Billings: Very shallow to deep, silty clay loam soils formed on level to strongly sloping uplands, alluvial fans, valley sides, and flood plains in residuum and alluvium derived from shale.	Persayo Billings	6-20 60+	0-15 0-5	Moderate wind erosion hazard, low to high water erosion hazard, poor topsoil, 10-17 inch precipitation zone. Shrink-swell potential is moderate, permeability is very slow to slow, calcareous.
32.5-36.25	13	Hagerman-Travessilla: Moderately deep to very shallow, fine sandy loam, loam, and gravelly sandy loam soils formed on nearly level to moderately steep uplands, mesa tops, valley bottoms, and flood plains in residuum derived from sandstone and in eolian and alluvial sediments of mixed origin. Includes steep sandstone (and some shale) outcrops.	Hagerman Travessilla	20-40 4-20	1-5 3-25	Moderate to high wind erosion hazard, moderate water erosion hazard, topsoil is good to poor, 10-17 inch precipitation zone. Shrink-swell potential is low, permeability is moderate to rapid, noncalcareous to slightly calcareous.
36.25-42.5	10; 13	Lohmiller-San Mateo: Deep, clay loam, clay, silty clay loam, loam, and sandy loam soils formed on level to gently sloping valley bottoms, flood plains, and terraces from alluvium derived primarily from sandstone and shale. Refer to Map Symbol - 13 (milepost 30.0-32.0).	Lohmiller San Mateo	60+ 60+	0-3 0-3	Moderate wind and water erosion hazard, topsoil is fair to good, 10-17 inch precipitation zone. Shrink-swell potential is low to high, permeability is very slow to moderate, calcareous.

Table 8. CHARACTERISTICS OF THE SOILS IDENTIFIED WITHIN THE 'N' TRANSMISSION CORRIDOR ALTERNATIVE (T3) (concluded)

Milepost	Map Symbol	Soil Association and Description	Soil Series	Depth to Bedrock (inches)	Slope (%)	Comments
McKinley County[2,4] (continued)						
42.5-47.5	13	Hagerman-Travessilla: Moderately deep to very shallow, fine sandy loam, loam, and gravelly sandy loam soils formed on nearly level to moderately steep uplands, mesa tops, valley bottoms, and flood plains in residuum derived from sandstone and in eolian and alluvial sediments of mixed origin. Includes steep sandstone (and some shale) outcrops.	Hagerman Travessilla	20-40 4-20	1-5 3-25	Moderate to high wind erosion hazard, moderate water erosion hazard, topsoil is good to poor, 10-17 inch precipitation zone. Shrink-swell potential is low, permeability is moderate to rapid, noncalcareous to slightly calcareous.
47.5-49.75	13;	Refer to Map Symbol - 13 (milepost 30.0-32.0).				
	18	Rock Land-Travessilla: Very shallow to shallow, fine sandy loam, and gravelly sandy loam soils formed on moderately sloping to moderately steep upland areas and mesa tops from materials derived primarily from sandstone and shale. Includes sandstone (and other sedimentary rock) outcrops on steep to extremely steep mesa sideslopes, escarpments, and breaks.	Travessilla	4-20	5-30	Moderate wind and water erosion hazard, poor topsoil, 10-17 inch precipitation zone. Shrink-swell potential is low, permeability is rapid, slightly calcareous.
49.75-60.0	13	Hagerman-Travessilla: Moderately deep to very shallow, fine sandy loam, loam, and gravelly sandy loam soils formed on nearly level to moderately steep uplands, mesa tops, valley bottoms, and flood plains in residuum derived from sandstone and in eolian and alluvial sediments of mixed origin. Includes steep sandstone (and some shale) outcrops.	Hagerman Travessilla	20-40 4-20	1-5 3-25	Moderate to high wind erosion hazard, moderate water erosion hazard, topsoil is good to poor, 10-17 inch precipitation zone. Shrink-swell potential is low, permeability is moderate to rapid, noncalcareous to slightly calcareous.
60.0-61.5	13/16	Refer to Map Symbols - 13 and 16 (mileposts 30.0-32.0 and 61.5-66.25, respectively).				
61.5-66.25	16	Travessilla-Persayo: Very shallow to shallow, fine sandy loam, gravelly sandy loam, silty clay loam, and silt loam soils formed on gently sloping to moderately steep flood plains, alluvial fans, valley slopes, mesas, ridges, canyon walls, escarpments, and breaks from alluvium and residuum derived primarily from sandstone and shale. Includes outcrops of interbedded sandstone and shale on steep escarpments and breaks.	Travessilla Persayo	4-20 6-20	3-25 3-25	Moderate wind and water erosion hazard, poor topsoil, 10-17 inch precipitation zone. Shrink-swell potential is low to moderate, permeability is slow to rapid, slightly calcareous and calcareous soils.
Sandoval County[3,4]						
66.25-75.5	6	Travessilla-Persayo: Very shallow to shallow, well drained, sandy loam, loam, and silty clay loam soils formed on gently sloping to moderately steep mesas and breaks from materials derived primarily from sandstone and shale.	Travessilla Persayo	6-16 0-16	3-25 9-25	Moderate wind and water erosion hazard, poor to fair topsoil, 10-14 inch precipitation zone. Shrink-swell potential is low to high, moderately alkaline soils.
75.5-106.0		Refer to Mileposts 70.5-101.0 of First Proposed Transmission Corridor (T2) (Table 6).				

Sources:

[1] U.S. Soil Conservation Service (SCS). 1979. General soil map, San Juan County, New Mexico, eastern part. Soil survey of San Juan County, New Mexico, eastern part.

[2] _________. 1974. General soil map of McKinley County, New Mexico. New Mexico State University, Agricultural Experiment Station, Research Report 262.

[3] _________. 1967. General soil map, Cabezon area, Sandoval County, New Mexico. Soil survey, Cabezon area, New Mexico.

[4] _________. 1971. General soil map of Sandoval and Los Alamos counties, New Mexico. New Mexico State University, Agricultural Experiment Station, Research Report 188.

are forming primarily in eolian, alluvial, and residual materials derived mainly from sandstone and shale, and to a lesser extent siltstone. These soils are forming primarily on gently sloping to moderately sloping mesas, plateaus, valley bottoms, valley sideslopes, intermittent drainageways, floodplains, alluvial fans, and breaks. This transmission corridor alternative traverses numerous intermittent drainages, as well as sandstone and shale outcrop (Badland) areas. Topsoil availability within this alternative transmission corridor is limited due to generally shallow soil surface layers, and the majority of the existing topsoil is of poor to fair quality due to undesirable surface textures (e.g., too sandy, gravelly, or clayey) or excess salt/sodium. Susceptibility of these soils to wind-induced erosion ranges from low to high. Susceptibility to water-induced soil erosion ranges from low to high, but it is primarily moderate. The majority of the soils identified within this corridor are alkaline and/or calcareous. Shrink-swell potential of the identified soils ranges from low to high. These soils are currently used primarily for livestock grazing and wildlife habitat, and to a lesser extent energy resource development.

Transmission Corridor T4. Alternative transmission corridor T4 is within the San Juan River Valley Mesas and Plateaus, New Mexico and Arizona Plateaus and Mesas, and Arizona and New Mexico Mountains portions of the Western Range and Irrigated Region (SCS 1978a). Annual precipitation generally ranges from 6 to 17 inches along this route. Seventeen different soil associations were identified within this transmission corridor. Table 9 lists (by mileposts) and characterizes the identified soils.

The soils identified within transmission corridor T4 are very shallow to deep, with surface textures ranging from loamy fine sand to clay. Permeability of these soils is very slow to rapid. These soils

Table 9. CHARACTERISTICS OF THE SOILS IDENTIFIED WITHIN THE TRANSMISSION CORRIDOR ALTERNATIVE T4

Milepost	Map Symbol	Soil Association and Description	Soil Series	Depth to Bedrock (inches)	Slope (%)	Comments
San Juan County[1]						
0.0-4.5	6/8	Refer to Map Symbols - 6 and 8 (mileposts 7.0-7.5 and 4.5-5.25, respectively).				
4.5-5.25	8	Badland-Rock Outcrop-Monierco: Shallow, well drained, fine sandy loam soils formed on level to moderately sloping knolls, mesas, and plateaus from alluvial and eolian materials derived primarily from sandstone and shale. Includes nonstony, barren shale areas on moderately sloping to extremely steep uplands that are dissected by deep intermittent drainageways and gullies; and barren sandstone outcrops on moderately sloping to extremely steep cliffs, ridges, breaks, and ledges.	Monierco	10-20	0-8	Moderate wind and water erosion hazard, poor topsoil, 6-10 inch precipitation zone. Shrink-swell potential is low to moderate, mild to moderately alkaline soils.
5.25-6.0	8;	Refer to Map Symbol - 8 (milepost 4.5-5.25).				
	3	Shiprock-Sheppard-Doak: Deep, well to somewhat excessively drained, fine sandy loam, loamy fine sand, and loam soils formed on level to moderately steep mesas, plateaus, and terraces from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Shiprock Sheppard Doak	60 60+ 60+	0-8 0-30 0-5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is fair to good, 6-10 inch precipitation zone. Shrink-swell potential is low to moderate, mildly to moderately alkaline soils.
6.0-6.25	8	Badland-Rock Outcrop-Monierco: Shallow, well drained, fine sandy loam soils formed on level to moderately sloping knolls, mesas, and plateaus from alluvial and eolian materials derived primarily from sandstone and shale. Includes nonstony, barren shale areas on moderately sloping to extremely steep uplands that are dissected by deep intermittent drainageways and gullies; and barren sandstone outcrops on moderately sloping to extremely steep cliffs, ridges, breaks, and ledges.	Monierco	10-20	0-8	Moderate wind and water erosion hazard, poor topsoil, 6-10 inch precipitation zone. Shrink-swell potential is low to moderate, mild to moderately alkaline soils.
6.25-7.0	8/6	Refer to Map Symbols - 8 and 6 (mileposts 4.5-5.25 and 7.0-7.5, respectively).				
7.0-7.5	6	Sheppard-Huerfano-Notal: Deep to shallow, well to somewhat excessively drained, loamy fine sand, sandy clay loam, and silty clay loam soils formed on level to steep mesas, plateaus, valley bottoms and fans from eolian, alluvial, and residual materials derived from sandstone, shale, and siltstone.	Sheppard Huerfano Notal	60+ 10-20 60	0-40 0-3 0-2	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to fair, 6-10 inch precipitation zone. Shrink-swell potential is low to high, moderately to strongly alkaline soils.
7.5-8.0	6/8	Refer to Map Symbols - 6 and 8 (mileposts 7.0-7.5 and 4.5-5.25, respectively).				

Table 9. CHARACTERISTICS OF THE SOILS IDENTIFIED WITHIN THE 'P' TRANSMISSION CORRIDOR ALTERNATIVE (T4) (continued)

Milepost	Map Symbol	Soil Association and Description	Soil Series	Depth to Bedrock (inches)	Slope (%)	Comments
San Juan County[1] (continued)						
8.0-14.5	8	Badland-Rock Outcrop-Monierco: Shallow, well drained, fine sandy loam soils formed on level to moderately sloping knolls, mesas, and plateaus from alluvial and eolian materials derived primarily from sandstone and shale. Includes nonstony, barren shale areas on moderately sloping to extremely steep uplands that are dissected by deep intermittent drainageways and gullies; and barren sandstone outcrops on moderately sloping to extremely steep cliffs, ridges, breaks, and ledges.	Monierco	10-20	0-8	Moderate wind and water erosion hazard, poor topsoil, 6-10 inch precipitation zone. Shrink-swell potential is low to moderate, mild to moderately alkaline soils.
14.5-20.25	6	Sheppard-Huerfano-Notal: Deep to shallow, well to somewhat excessively drained, loamy fine sand, sandy clay loam, and silty clay loam soils formed on level to steep mesas, plateaus, valley bottoms and fans from eolian, alluvial, and residual materials derived from sandstone, shale, and siltstone.	Sheppard Huerfano Notal	60+ 10-20 60	0-40 0-3 0-2	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to fair, 6-10 inch precipitation zone. Shrink-swell potential is low to high, moderately to strongly alkaline soils.
McKinley County[2]						
20.25-25.0	3;	Refer to Map Symbol - 3 (milepost 25.0-27.5).				
	4	Chipeta-Sheppard-Shiprock: Shallow to deep, silty clay, clay, loamy sand, loamy fine sand, and fine sand soils formed on level to strongly sloping uplands, ridges, and valley sideslopes from alluvial, eolian, and residual materials derived primarily from shale and sandstone.	Chipeta Sheppard Shiprock	10-20 60+ 60+	0-15 1-9 0-5	Low to high wind and water erosion hazard, topsoil is poor, 10-17 inch precipitation zone. Shrink-swell potential is low to high, permeability is very slow to rapid, calcareous and noncalcareous soils.
25.0-27.5	3	Rock Land-Billings: Very shallow to deep, silty clay loam, silt loam, silty clay, clay, sandy loam, and loamy fine sand soils formed on nearly level to moderately steep ledges, benches, escarpments valley bottoms, and valley sides from materials derived from sandstone, shale, and other sedimentary rocks. Includes numerous steep to extremely steep outcrops of sandstone and shale.	Billings	60+	0-5	Low to moderate wind erosion hazard, high water erosion hazard, poor topsoil, 10-17 inch precipitation zone. Shrink-swell potential is moderate, permeability is very slow to slow, calcareous. Some areas within the Billings portion may contain toxic amounts of soluble salts, subject to piping and severe gully erosion.
27.5-29.0	1;	Persayo-Camborthids: Very shallow to moderately deep, silt loam, silty clay loam, and fine sandy loam soils formed on nearly level to strongly sloping uplands in residuum derived primarily from sandstone. Includes steep to extremely steep sandstone and interbedded shale outcrops.	Persayo Camborthids	6-20 20-36	1-15 1-8	Moderate to high wind erosion hazard, moderate water erosion hazard, poor topsoil, 10-17 inch precipitation zone. Shrink-swell potential is low to moderate, permeability is slow to moderate, calcareous.
	13	Refer to Map Symbol - 13 (milepost 35.75-36.75).				
29.0-33.5	10/13	Refer to Map Symbols - 10 and 13 (mileposts 33.5-34.0 and 35.75-36.75, respectively).				

Table 9. CHARACTERISTICS OF THE SOILS IDENTIFIED WITHIN THE 'P' TRANSMISSION CORRIDOR ALTERNATIVE (T4) (continued)

Milepost	Map Symbol	Soil Association and Description	Soil Series	Depth to Bedrock (inches)	Slope (%)	Comments
McKinley County[2] (continued)						
33.5-34.0	10	Lohmiller-San Mateo: Deep, clay loam, clay, silty clay loam, loam, and sandy loam soils formed on level to gently sloping valley bottoms, flood plains, and terraces from alluvium derived primarily from sandstone and shale.	Lohmiller San Mateo	60+ 60+	0-3 0-3	Moderate wind and water erosion hazard, topsoil is fair to good, 10-17 inch precipitation zone. Shrink-swell potential is low to high, permeability is very slow to moderate, calcareous.
34.0-35.75	10/13	Refer to Map Symbols - 10 and 13 (mileposts 33.5-34.0 and 35.75-36.75, respectively).				
35.75-36.75	13	Hagerman-Travessilla: Moderately deep to very shallow, fine sandy loam, loam, and gravelly sandy loam soils formed on nearly level to moderately steep uplands, mesa tops, valley bottoms, and flood plains in residuum derived from sandstone and in eolian and alluvial sediments of mixed origin. Includes steep sandstone (and some shale) outcrops.	Hagerman Travessilla	20-40 4-20	1-5 3-25	Moderate to high wind erosion hazard, moderate water erosion hazard, topsoil is good to poor, 10-17 inch precipitation zone. Shrink-swell potential is low, permeability is moderate to rapid, noncalcareous to slightly calcareous.
36.75-38.75	10/13	Refer to Map Symbols - 10 and 13 (mileposts 33.5-34.0 and 35.75-36.75, respectively).				
38.75-60.0	13	Hagerman-Travessilla: Moderately deep to very shallow, fine sandy loam, loam, and gravelly sandy loam soils formed on nearly level to moderately steep uplands, mesa tops, valley bottoms, and flood plains in residuum derived from sandstone and in eolian and alluvial sediments of mixed origin. Includes steep sandstone (and some shale) outcrops.	Hagerman Travessilla	20-40 4-20	1-5 3-25	Moderate to high wind erosion hazard, moderate water erosion hazard, topsoil is good to poor, 10-17 inch precipitation zone. Shrink-swell potential is low, permeability is moderate to rapid, noncalcareous to slightly calcareous.
60.0-68.5	18	Rock Land-Travessilla: Very shallow to shallow, fine sandy loam, and gravelly sandy loam soils formed on moderately sloping to moderately steep upland areas and mesa tops from materials derived primarily from sandstone and shale. Includes sandstone (and other sedimentary rock) outcrops on steep to extremely steep mesa sideslopes, escarpments, and breaks.	Travessilla	4-20	5-30	Moderate wind and water erosion hazard, poor topsoil, 10-17 inch precipitation zone. Shrink-swell potential is low, permeability is rapid, slightly calcareous.
68.5-68.75	15;	Las Lucas-Litle-Persayo: Deep to very shallow, loam, clay, silty clay loam, and silt loam soils formed on nearly level to moderately sloping alluvial fans, valley sideslopes, uplands, ridges, and knolls from alluvial and residual materials derived primarily from shale. Includes interbedded shale and sandstone exposures on steep escarpments and breaks.	Las Lucas Litle Persayo	40-60 20-40 6-20	3-5 3-5 1-9	Low to moderate wind erosion hazard, moderate to high water erosion hazard, topsoil is fair to poor, 7-10 inch precipitation zone. Shrink-swell potential is moderate to high, slow to very slow permeability, calcareous.
	18;	Refer to Map Symbol - 18 (milepost 60.0-68.5).				

Table 9. CHARACTERISTICS OF THE SOILS IDENTIFIED WITHIN THE 'P' TRANSMISSION CORRIDOR ALTERNATIVE (T4) (continued)

Milepost	Map Symbol	Soil Association and Description	Soil Series	Depth to Bedrock (inches)	Slope (%)	Comments
McKinley County[2] (continued)						
	19	Rock Land-Bond: Very shallow to shallow, fine sandy loam, sandy loam, and gravelly sandy loam soils formed on nearly level to moderately steep mesas, ridges, escarpments, and breaks from residual materials derived primarily from sandstone, and to a lesser extent from eolian and alluvial materials of mixed origin. Includes numerous steep to extremely steep outcrops of sandstone and other sedimentary rocks.	Bond	10-20	1-5	Moderate wind and water erosion hazard, poor topsoil, 10-17 inch precipitation zone. Shrink-swell potential is low to moderate, permeability is slow to rapid, noncalcareous.
68.75-71.5	18/19	Refer to Map Symbols - 18 and 19 (mileposts 60.0-68.5 and 68.5-68.75, respectively).				
71.5-72.0	18	Rock Land-Travessilla: Very shallow to shallow, fine sandy loam, and gravelly sandy loam soils formed on moderately sloping to moderately steep upland areas and mesa tops from materials derived primarily from sandstone and shale. Includes sandstone (and other sedimentary rock) outcrops on steep to extremely steep mesa sideslopes, escarpments, and breaks.	Travessilla	4-20	5-30	Moderate wind and water erosion hazard, poor topsoil, 10-17 inch precipitation zone. Shrink-swell potential is low, permeability is rapid, slightly calcareous.
72.0-72.5	18/13	Refer to Map Symbols - 18 and 13 (mileposts 60.0-68.5 and 35.75-36.75, respectively).				
72.5-73.0	18	Rock Land-Travessilla: Very shallow to shallow, fine sandy loam, and gravelly sandy loam soils formed on moderately sloping to moderately steep upland areas and mesa tops from materials derived primarily from sandstone and shale. Includes sandstone (and other sedimentary rock) outcrops on steep to extremely steep mesa sideslopes, escarpments, and breaks.	Travessilla	4-20	5-30	Moderate wind and water erosion hazard, poor topsoil, 10-17 inch precipitation zone. Shrink-swell potential is low, permeability is rapid, slightly calcareous.
73.0-75.0	10/18/19	Refer to Map Symbols - 10, 18, and 19 (mileposts 33.5-34.0; 60.0-68.5; and 68.5-68.75, respectively).				
75.0-75.5	10/18	Refer to Map Symbols - 10 and 18 (mileposts 33.5-34.0 and 60.0-68.5, respectively).				
75.5-76.0	23/15	Refer to Map Symbols - 23 and 15 (mileposts 76.0-79.5 and 68.5-68.75, respectively).				
76.0-79.5	23	Rock Land-Thunderbird: Shallow to moderately deep, stony clay loam, stony loam, and loam soils formed on level to strongly sloping mesas, ridge tops, escarpments, and breaks from materials weathered from volcanic rocks (primarily basalt), and to a lesser extent from eolian materials of mixed origin. Includes numerous steep to extremely steep outcrops of basalt or occasionally sedimentary rocks.	Thunderbird	20-40	0-10	Low to moderate wind erosion hazard, moderate water erosion hazard, poor topsoil, 10-17 inch precipitation zone. Shrink-swell potential is moderate to high, permeability is very slow, noncalcareous.
79.5-80.5	23/15	Refer to Map Symbols - 23 and 15 (mileposts 76.0-79.5 and 68.5-68.75, respectively).				

Table 9. CHARACTERISTICS OF THE SOILS IDENTIFIED WITHIN THE 'P' TRANSMISSION CORRIDOR ALTERNATIVE (T4) (continued)

Milepost	Map Symbol	Soil Association and Description	Soil Series	Depth to Bedrock (inches)	Slope (%)	Comments
McKinley County[2] (continued)						
80.5-96.0	23	Rock Land-Thunderbird: Shallow to moderately deep, stony clay loam, stony loam, and loam soils formed on level to strongly sloping mesas, ridge tops, escarpments, and breaks from materials weathered from volcanic rocks (primarily basalt), and to a lesser extent from eolian materials of mixed origin. Includes numerous steep to extremely steep outcrops of basalt or occasionally sedimentary rocks.	Thunderbird	20-40	0-10	Low to moderate wind erosion hazard, moderate water erosion hazard, poor topsoil, 10-17 inch precipitation zone. Shrink-swell potential is moderate to high, permeability is very slow, noncalcareous.
Cibola County[3]						
96.0-100.0	14	Rock Land-Thunderbird: Shallow to moderately deep, stony clay loam, stony loam, and silt loam soils formed on level to strongly sloping basalt capped mesas, lava flows, and volcanic hills from materials derived primarily from basic volcanic rocks (basalt). Includes outcrops of basalt, sandstone, and other sedimentary bedrocks on steep to very steep mesa sides, escarpments, lava flow fronts, hills, and ridges.	Thunderbird	20-40	0-10	Low wind erosion hazard, moderate water erosion hazard, poor topsoil, 7-10 inch precipitation zone. Shrink-swell potential is moderate to high, permeability is very slow to slow, noncalcareous.
100.0-102.25	15	Litle-Clovis-Travessilla: Moderately deep to very shallow, silty clay loam, clay, fine sandy loam, loam, stony sandy loam, and sandy loam soils formed on level to moderately steep uplands, mesas, hills, ridges, breaks, escarpments, and flood plains from residuum derived from sandstone and shale, and to a lesser extent from alluvial and eolian materials of similar origin.	Litle Clovis Travessilla	20-40 20-40 8-20	0-20 0-10 5-30	Low to moderate wind erosion hazard, moderate water erosion hazard, poor to fair topsoil, 7-10 inch precipitation zone. Shrink-swell potential is low to high, permeability is very slow to rapid, calcareous and noncalcareous soils.
Sandoval County[4]						
102.25-103.25	11	Las Lucas-Litle-Persayo: Deep to very shallow, clay, loam, silty clay loam, and silt loam soils formed on nearly level to moderately sloping alluvial fans, valley side slopes, uplands, ridges, and knolls from materials derived from weathered shale. Includes steep to very steep shale and sandstone outcrops.	Las Lucas Litle Persayo	40-60 20-40 6-18	3-5 3-5 1-9	Low wind erosion hazard, moderate to high water erosion hazard, fair to poor topsoil, 10-14 inch precipitation zone. Shrink-swell potential is moderate to high, permeability is slow to very slow, calcareous.
103.25-104.0	13	Travessilla-Persayo-Rockland: Very shallow to shallow, sandy loam, silty clay loam, and silt loam soils formed on gently sloping to moderately steep mesas, breaks, ridges, and knolls from sandstone and shale. Includes interbedded sandstone and shale outcrops on moderately steep to extremely steep escarpments and breaks.	Travessilla Persayo	8-20 3-25	3-25 3-25	Moderate wind and water erosion hazard, topsoil is poor, 10-14 inch precipitation zone. Shrink-swell potential is low to moderate, permeability is rapid to slow, slightly calcareous and calcareous soils.

Table 9. CHARACTERISTICS OF THE SOILS IDENTIFIED WITHIN THE 'P' TRANSMISSION CORRIDOR ALTERNATIVE (T4) (continued)

Milepost	Map Symbol	Soil Association and Description	Soil Series	Depth to Bedrock (inches)	Slope (%)	Comments
Sandoval County[4] (continued)						
104.0-105.0	11/13	Refer to Map Symbols - 11 and 13 (mileposts 102.25-103.25 and 103.25-104.0, respectively).				
105.0-105.5	11	Las Lucas-Litle-Persayo: Deep to very shallow, clay, loam, silty clay loam, and silt loam soils formed on nearly level to moderately sloping alluvial fans, valley side slopes, uplands, ridges, and knolls from materials derived from weathered shale. Includes steep to very steep shale and sandstone outcrops.	Las Lucas Litle Persayo	40-60 20-40 6-18	3-5 3-5 1-9	Low wind erosion hazard, moderate to high water erosion hazard, fair to poor topsoil, 10-14 inch precipitation zone. Shrink-swell potential is moderate to high, permeability is slow to very slow, calcareous.
105.5-108.5	13	Travessille-Persayo-Rockland: Very shallow to shallow, sandy loam, silty clay loam, and silt loam soils formed on gently sloping to moderately steep mesas, breaks, ridges, and knolls from sandstone and shale. Includes interbedded sandstone and shale outcrops on moderately steep to extremely steep escarpments and breaks.	Travessille Persayo	8-20 3-25	3-25 3-25	Moderate wind and water erosion hazard, topsoil is poor, 10-14 inch precipitation zone. Shrink-swell potential is low to moderate, permeability is rapid to slow, slightly calcareous and calcareous soils.
108.5-109.0	2/13	Refer to Map Symbols - 2 and 13 (mileposts 109.0-111.5 and 103.25-104.0, respectively).				
109.0-111.5	2	Christianburg-Navajo: Deep, clay, silty clay loam, and sandy clay loam soils formed on level to gently sloping valley bottoms, flood plains, and terraces from alluvium derived primarily from shale.	Christianburg Navajo	60+ 60+	0-3 0-3	Low wind erosion hazard, moderate to high water erosion hazard, poor topsoil, 10-14 inch precipitation zone. Shrink-swell potential is high, permeability is very slow, calcareous.
111.5-115.0	2/13	Refer to Map Symbols - 2 and 13 (mileposts 109.0-111.5 and 103.25-104.0, respectively).				
115.0-117.25	13	Travessilla-Persayo-Rockland: Very shallow to shallow, sandy loam, silty clay loam, and silt loam soils formed on gently sloping to moderately steep mesas, breaks, ridges, and knolls from sandstone and shale. Includes interbedded sandstone and shale outcrops on moderately steep to extremely steep escarpments and breaks.	Travessilla Persayo	8-20 3-25	3-25 3-25	Moderate wind and water erosion hazard, topsoil is poor, 10-14 inch precipitation zone. Shrink-swell potential is low to moderate, permeability is rapid to slow, slightly calcareous and calcareous soils.
117.25-117.75	2	Christianburg-Navajo: Deep, clay, silty clay loam, and sandy clay loam soils formed on level to gently sloping valley bottoms, flood plains, and terraces from alluvium derived primarily from shale.	Christianburg Navajo	60+ 60+	0-3 0-3	Low wind erosion hazard, moderate to high water erosion hazard, poor topsoil, 10-14 inch precipitation zone. Shrink-swell potential is high, permeability is very slow, calcareous.
117.75-118.25	2/13	Refer to Map Symbols - 2 and 13 (mileposts 109.0-111.5 and 103.25-104.0, respectively).				
118.25-118.5	13	Travessilla-Persayo-Rockland: Very shallow to shallow, sandy loam, silty clay loam, and silt loam soils formed on gently sloping to moderately steep mesas, breaks, ridges, and knolls from sandstone and shale. Includes interbedded sandstone and shale outcrops on moderately steep to extremely steep escarpments and breaks.	Travessilla Persayo	8-20 3-25	3-25 3-25	Moderate wind and water erosion hazard, topsoil is poor, 10-14 inch precipitation zone. Shrink-swell potential is low to moderate, permeability is rapid to slow, slightly calcareous and calcareous soils.

Table 9. CHARACTERISTICS OF THE SOILS IDENTIFIED WITHIN THE 'P' TRANSMISSION CORRIDOR ALTERNATIVE (T4) (concluded)

Milepost	Map Symbol	Soil Association and Description	Soil Series	Depth to Bedrock (inches)	Slope (%)	Comments
Sandoval County[4] (continued)						
118.5-119.5	2/13	Refer to Map Symbols - 2 and 13 (mileposts 109.0-111.5 and 103.25-104.0, respectively).				
119.5-120.25	2	Christianburg-Navajo: Deep, clay, silty clay loam, and sandy clay loam soils formed on level to gently sloping valley bottoms, flood plains, and terraces from alluvium derived primarily from shale.	Christianburg Navajo	60+ 60+	0-3 0-3	Low wind erosion hazard, moderate to high water erosion hazard, poor topsoil, 10-14 inch precipitation zone. Shrink-swell potential is high, permeability is very slow, calcareous.
120.25-122.25	11	Las Lucas-Litle-Persayo: Deep to very shallow, clay, loam, silty clay loam, and silt loam soils formed on nearly level to moderately sloping alluvial fans, valley side slopes, uplands, ridges, and knolls from materials derived from weathered shale. Includes steep to very steep shale and sandstone outcrops.	Las Lucas Litle Persayo	40-60 20-40 6-18	3-5 3-5 1-9	Low wind erosion hazard, moderate to high water erosion hazard, fair to poor topsoil, 10-14 inch precipitation zone. Shrink-swell potential is moderate to high, permeability is slow to very slow, calcareous.
122.25-124.0	7	Rough Broken Land-Embudo: Shallow to moderately deep, gravelly fine sandy loam, fine sandy loam, gravelly sandy loam, and gravelly loamy sand soils formed on nearly level to moderately steep uplands dissected by numerous intermittent drainages and arroyos as well as breaks, ridges, and to a lesser extent valley bottoms and flood plains. These soils are forming primarily in unconsolidated alluvium.	Embudo	20-36	1-9	Low wind erosion hazard, moderate water erosion hazard, topsoil is poor, 10-14 inch precipitation zone. Shrink-swell potential is low, permeability is rapid, calcareous.

Sources:

[1] U.S. Soil Conservation Service (SCS). 1979. General soil map, San Juan County, New Mexico, eastern part. Soil survey of San Juan County, New Mexico, eastern part.

[2] ________. 1974. General soil map of McKinley County, New Mexico. New Mexico State University, Agricultural Experiment Station, Research Report 262.

[3] ________. 1974. General soil map of Valencia County, New Mexico. New Mexico State University, Agricultural Experiment Station, Research Report 267.

[4] ________. 1971. General soil map of Sandoval and Los Alamos counties, New Mexico. New Mexico State University, Agricultural Experiment Station, Research Report 188.

are forming primarily in alluvial, eolian, and residual materials derived from sandstone, shale, siltstone, and to a lesser extent volcanic rock (e.g., basalt). These soils are forming primarily on gently sloping to moderately sloping mesas, plateaus, ridges, knolls, canyons, valleys, intermittent drainageways, floodplains, and alluvial fans. Transmission corridor T4 traverses numerous intermittent drainageways and numerous Rock Outcrop (sandstone, shale, and basalt) areas on strongly sloping to steep ridges, escarpments, and breaks. The main areas of steep terrain are in southern McKinley County (e.g., San Lucas Canyon area), southeastern McKinley County (between Canon de Marquez and Canon de Pedro Padilla), and in northeastern Cibola County (La Mesa del Canon Seco area). Topsoil availability within this alternative transmission corridor is limited due to generally shallow soil surface layers, and the majority of the existing topsoil is of poor to fair quality due to undesirable surface textures (e.g., too gravelly, stony, sandy, or clayey) or excess salt/sodium. Susceptibility of these soils to wind-induced erosion is primarily moderate to high, and susceptibility to water-induced soil erosion ranges from low to high. Approximately 50 percent of the soils identified within this transmission corridor are alkaline and/or calcareous. Shrink-swell potential of the identified soils ranges from low to high. These soils are currently used primarily for livestock grazing and wildlife habitat, and to a lesser extent for energy resource development.

PRIME AND UNIQUE FARMLANDS

Proposed NMGS Site

Since the proposed NMGS could potentially take agricultural land out of production for the life of the project, the NMGS site was evaluated to determine whether it includes any Prime and/or Unique Farmland. The soil survey of San Juan County (SCS 1980) was used in conjunction with the Prime Farmland list (soil mapping units) for San Juan County (SCS 1978b) for this evaluation. The soil types (BA and SC) present at the proposed NMGS site do not meet the criteria for Prime Farmland. Additionally, the proposed NMGS site does not contain any Unique or Statewide/Locally Important Farmland.

Water Supply System

Proposed Main Water Pipeline (P1). The proposed intake/pumping plant and the three intermediate pump stations associated with this pipeline could potentially take agricultural land out of production for the life of the project, so these project component locations were evaluated for Prime Farmland potential.

The soil type (Wr) present at the proposed intake/pumping plant is potential Prime Farmland (SCS 1978b and 1980). For this area to qualify as Prime Farmland it must be irrigated and used for cropland. This area is not used for cropland and is not irrigated, thus this area does not qualify as Prime Farmland. Additionally, this area contains no Unique or Statewide/Locally Important Farmlands. The soil types (FA, Ay, Sm, and Sd) present at the three intermediate pump station locations do not meet the criteria for Prime Farmland (SCS 1978b and 1980). The three intermediate pump station locations contain no Unique or Statewide/Locally Important Farmlands. Intermediate pump stations 2 and 3 are in an irrigable portion of the Navajo Indian Irrigation Project (NIIP) - Block 9, which is currently undeveloped (i.e., potential Statewide/Locally Important Farmland). Congress has cut off funding for NIIP indefinitely, thus it is very likely Block 9 will never be developed.

Main Water Pipeline Alternatives P2 and P3. The soil types (Fy, RA, and Fw) present at the intake/pumping plant locations associated with these main water pipeline alternatives do not meet the criteria for Prime Farmland (SCS 1978b and 1980). The intake/pumping plant locations contain no Unique or Statewide/Locally Important Farmlands either.

The soil types (FX, BA, Sd, and DS) present at the intermediate pump station locations associated with these pipeline alternatives do not meet the criteria for Prime Farmland (SCS 1978b and 1980). These intermediate pump station locations also contain no Unique or Statewide/Locally Important Farmlands.

Proposed Terminal Storage Reservoir (R1). The soil types (BA, SC. and HU) present at the proposed reservoir location do not qualify as Prime Farmland (SCS 1978b and 1980). The proposed site contains no Unique or Statewide/Locally Important Farmlands.

Terminal Storage Reservoir Alternative (R2). The soil types (HU and DN) present at this alternative reservoir site do not qualify as Prime Farmland either (SCS 1978b and 1980). Additionally, the alternative reservoir site does not contain any Unique or Statewide/Locally Important Farmlands.

Transmission Lines

The proposed and alternative transmission line corridors do not traverse any irrigated cropland, thus no Unique or Statewide/Locally Important Farmlands would be taken out of production by surface facilities associated with the transmission system.

Proposed FC-A-P 500-kV Transmission Line Loop (T5). Transmission towers and substations associated with transmission lines could potentially take agricultural land out of production for the life of the project. Since tower locations are unknown at this time, the entire transmission corridors were evaluated for the presence of potential Prime Farmland.

The soil types (SC, BA, and RA) present within the proposed FC-A-P 500-kV transmission line loop corridor do not qualify as Prime Farmland (SCS 1978b and 1980).

First Proposed Transmission Line Corridor (T2). The soils present within the portion of this corridor in San Juan County do not meet the criteria for Prime Farmland. A Land Class For Irrigation (LCFI) of 1 qualifies as potential Prime Farmland (if irrigated), but the highest rating for the soils within this corridor segment is LCFI 2-3 (SCS 1973).

The soils present within the portion of this corridor in McKinley and Sandoval counties do not qualify as Prime Farmland (Fjefeth 1981, and Hacker 1981).

Second Proposed Transmission Line Corridor (T1). The soils present within the portion of this corridor in San Juan County do not meet the criteria for Prime Farmland, because the highest LCFI rating is 2-3 (SCS 1973).

The soils present within the portion of this corridor in McKinley and Sandoval counties do not qualify as Prime Farmland (Fjefeth 1981, and Hacker 1981).

Transmission Line Corridor Alternative T3. The soils present within the portion of this corridor in San Juan County do not meet the criteria for Prime Farmland, because the highest LCFI rating is 4-6 (SCS 1973).

The soils present within the portion of this corridor in McKinley and Sandoval counties do not qualify as Prime Farmland (Fjefeth 1981, and Hacker 1981).

Transmission Line Corridor Alternative T4. The soils present within the portion of this corridor in San Juan County do not meet the criteria for Prime Farmland, because the highest LCFI rating is 6-2 (SCS 1973).

The soils present within the portion of this corridor in McKinley and Sandoval counties do not qualify as Prime Farmland (Fjefeth 1981, and Hacker 1981).

The soils present within the portion of this corridor in Cibola County do not meet the criteria for Prime Farmland, because the highest LCFI rating is 6-4-3 (SCS 1974).

4.0

ENVIRONMENTAL CONSEQUENCES

SOILS

Proposed NMGS Site

Construction of the proposed NMGS would disturb approximately 2400 acres of soils and topography, significantly affecting the existing soils (see Table 10). The soils at the NMGS site would be taken out of production for the life of the project. Depending on the amount of grading and excavation necessary, existing soil profiles could be completely altered or destroyed during site preparation. Topsoil (or salvageable soil) removal, stockpiling, and redistribution would result in an intermixing of the native topsoils. Depending on the specific topsoil removal plan chosen (e.g., selective or nonselective by soil types, salvage depths), topsoil may also be salvaged and mixed with less desirable subsoils or bedrock. Alteration of the existing soil profiles, and mixing of topsoil or salvageable soil would alter the physical, chemical, and biological characteristics of the native soils. For example, physical features affected include surface textures, soil structure, permeability, and infiltration rates; chemical features include pH, sodium levels, macro- and micronutrients; biological features include the type and quantity of soil microorganisms.

The primary goal of a reclamation plan is to ensure that lands disturbed during construction or operation are restored to a stable, productive, and aesthetically acceptable condition. Although a detailed construction and reclamation plan is not yet available, the applicant has proposed several general mitigation measures and reclamation procedures that would be employed at the NMGS site.

During site preparation, the entire plant area would be step graded, but existing contours would be preserved to the maximum practical extent to avoid excessive cut-and-fill operations. During construction, erosion control would consist of drainage ditches across disturbed areas that would tie into the existing surface drainage features. Siltation control measures would include sedimentation ponds, sediment traps, and controlled drainage slopes. Topsoil would be removed and stockpiled by construction equipment prior to required excavations. The topsoil stockpiles would be shaped and graded for drainage and erosion control. The stockpiled topsoil would be redistributed on spoil-disposal and disturbed areas prior to revegetation. All disturbed nonroad areas (not covered with asphalt, concrete, or gravel) would be reseeded with native grasses.

The effects of unavoidable impacts to the soils resource as a result of constructing NMGS would include: (1) accelerated soil erosion due to wind and water; (2) decreased soil stability; (3) decreased soil diversity in chemical, physical, and topographic aspects; (4) decreased soil fertility and productivity; (5) decreased soil development; and (6) decreased quantity, quality, and diversity of vegetative cover.

The soils data for NMGS in the Affected Environment section (including Table 1) of this background report indicate that some of the sites may be difficult to reclaim due to adverse physical and chemical soil properties, such as: undesirable surface textures, absence of and/or restricted topsoil supply, high erosion susceptibility, excess salts, and alkalinity. In addition, the low precipitation at the site could inhibit reclamation efforts. Selection of seed species specifically adapted to local soils and climate, as well as timing and methods of reseeding, are essential prerequisites for successful revegetation on problem soil areas (e.g., soils with excess salts, high alkalinity, droughtiness). Excess salts and alkalinity problems could increase in some areas if excavated materials, which in some cases are more toxic than the overlying topsoils, were placed on the surface. Shale is mildly to strongly alkaline and extremely difficult to vegetate, thus shale should not be mixed with topsoil or placed on the surface.

Potential soils reclamation problem areas at NMGS are listed in Table 10 by soil association and the specific indicators of potential reclamation problems. Table 10 also lists potential mitigation measures which, if implemented, would increase reclamation success at the site. The applicant's Proposed Action includes most of the measures.

Water Supply System

Proposed Main Water Pipeline (P1). Construction of the proposed main water pipeline P1 (including intake pumping plant and intermediate pump stations) would directly disturb approximately 474 acres of soil and topography (see Table 10). Construction of staging and work areas at pump station sites and stream, road, and canal crossings would cause a small amount of additional disturbance. Soil surface disturbance, excavation (trenching operations), and removal of vegetative cover would increase the present soil erosion rates and soil instability. These increases would continue until denuded areas were revegetated. If a moderately intensive erosion control and reclamation program were implemented following construction, most of

Table 10. SUMMARY OF POTENTIAL SOILS RECLAMATION PROBLEM AREAS[1]

Project Component	Map Unit or Soil Association[2]	Approximate Milepost or Acreage	Indicators of Potential Reclamation Problems				Comments	Potential Mitigation Measures for Consideration[7]
			High Wind Erosion Susceptibility[3]	High Water Erosion Susceptibility[4]	Area Reclaim[5]	Steep Terrain[6]		
NMGS								
	Shiprock-Sheppard-Huerfano	911	X	-	-	-	Shiprock-Sheppard portion is highly susceptible to wind erosion.	A,B,D
	Turley-Fruitland-Blancot	882	X	-	-	-	Fruitland portion may be highly susceptible to wind erosion.	A,B,D
	Stumble-Notal-Huerfano	439	X	-	-	-	Stumble portion may be highly susceptible to wind erosion; Notal portion is highly susceptible to shrink-swell.	A,B,C,D
	Riverwash-Duneland	114	X	X	-	-	Duneland portion is highly susceptible to wind erosion; Riverwash portion is highly susceptible to water erosion.	A,B,C,D
	Badland-Rock Outcrop	54	-	X	-	X	Badland areas (>15% slope) are highly susceptible to water erosion in excavated areas, if loose/broken up shale is left unprotected on the surface.	C
		Totals[8]	2346 acres	168 acres	0	54 acres		
Water Supply System								
P1	HA/BC	0.05-0.2	-	-	X	X	Adit/shaft area (i.e., precludes soils problems).	
	FA	0.2-0.6, 0.65-0.75, 0.85-1.95	-	-	X	-	Persayo portion - area reclaim, shallow soils.	A,B,C,D
	Ay	0.6-0.65, 0.75-0.85	-	X	-	-	This phase of the Avalon series is highly susceptible to water erosion.	A,B,C,D
	FX	1.95-2.7, 2.85-3.05, 3.15-3.3	X	-	X	-	Sheppard portion is highly susceptible to wind erosion; Persayo portion - area reclaim.	A,B,C,D
	BC	3.05-3.15	-	-	X	-	Persayo portion - area reclaim, shallow soils.	A,B,C,D

Table 10. SUMMARY OF POTENTIAL SOILS RECLAMATION PROBLEM AREAS[1] (continued)

Project Component	Map Unit or Soil Association[2]	Approximate Milepost or Acreage	Indicators of Potential Reclamation Problems: High Wind Erosion Susceptibility[3]	High Water Erosion Susceptibility[4]	Area Reclaim[5]	Steep Terrain[6]	Comments	Potential Mitigation Measures for Consideration[7]
Water Supply System (continued)								
P1	Sd	3.3-3.65, 3.9-4.0, 4.35-6.0, 6.25-13.0, 13.15-13.2, 13.25-13.6, 13.7-14.1, 14.5-14.8, 15.25-15.45, 22.95-23.0, 23.5-23.55, 23.7-23.8, 23.85-23.95, 24.0-24.9, 25.3-26.1, 26.25-28.4, 28.85-29.15, 29.35-29.6	X	-	-	-	Sheppard-Mayqueen portion is highly susceptible to wind erosion.	A,B,D
	BA	15.45-16.8	-	X	-	X	Badland areas (>15% slope) are highly susceptible to water erosion in trenched areas.	C
	AZ	16.8-17.3	X	-	-	-	Sheppard portion is highly susceptible to wind erosion.	A,B,D
	HU	17.3-19.2, 22.85-22.9, 23.4-23.5	-	-	X	-	Muff portion - area reclaim.	A,B,C,D
	SC	19.2-22.7, 22.8-22.85, 23.3-23.4, 28.4-28.85, 29.15-29.35, 29.6-30.8, 33.3-35.0, 35.4-35.95, 38.4-39.2, 39.55-39.7	X	-	-	-	Sheppard portion is highly susceptible to wind erosion; Notal portion is highly susceptible to shrink-swell.	A,B,C,D
	Riverwash-Duneland	35.95-36.05	X	X	-	-	Duneland portion is highly susceptible to wind erosion; Riverwash portion is highly susceptible to water erosion.	A,B,C,D
	Turley-Fruitland-Blancot	36.05-36.6, 37.2-37.75, 37.95-38.3	X	-	-	-	Fruitland portion may be highly susceptible to wind erosion.	A,B,C,D
	Shiprock-Sheppard-Huerfano	36.6-37.2, 38.3-38.4	X	-	-	-	Shiprock-Sheppard portion is highly susceptible to wind erosion.	A,B,C,D
		Totals[8]	31.7 miles	1.6 miles	4.4 miles	1.35 miles		

Table 10. SUMMARY OF POTENTIAL SOILS RECLAMATION PROBLEM AREAS[1] (continued)

Project Component	Map Unit or Soil Association[2]	Approximate Milepost or Acreage	Indicators of Potential Reclamation Problems				Comments	Potential Mitigation Measures for Consideration[7]
			High Wind Erosion Susceptibility[3]	High Water Erosion Susceptibility[4]	Area Reclaim[5]	Steep Terrain[6]		
Water Supply System (continued)								
P2[9]	HA	0.25-0.3, 0.95-1.0, 2.3-2.5	-	X	X	-	Haplargids-Torriorthents portion may be highly susceptible to water erosion; Blackston portion - area reclaim.	A,B,C,D
	Ay	0.3-0.75	-	X	-	-	This phase of the Avalon series is highly susceptible to water erosion.	A,B,C,D
	FX	0.75-0.95, 2.55-4.4, 5.35-5.65, 5.75-5.9, 14.15-14.25, 14.5-14.6, 18.05-18.1, 18.3-18.45	X	-	X	-	Sheppard portion is highly susceptible to wind erosion; Persayo portion - area reclaim.	A,B,C,D
	GY	1.6-1.85	X	-	-	-	Gypsiorthids-Stumble portion is highly susceptible to wind erosion.	A,B,D
	SZ	2.0-2.1, 13.45-13.55	X	-	-	-	Stumble portion is highly susceptible to wind erosion.	A,B,D
	RA	2.1-2.25, 2.5-2.55, 4.7-4.75, 13.55-13.6, 14.0-14.15, 18.2-18.3	-	X	-	-	Riverwash is highly susceptible to water erosion.	A
	BA	4.4-4.7, 4.85-5.35, 14.6-15.0	-	X	-	X	Badland areas (>15% slope) are highly susceptible to water erosion in trenched areas.	C
	Sd	5.65-5.75, 5.9-6.9, 7.0-7.45, 7.75-8.8, 9.1-9.95, 10.1-13.3, 13.6-13.8, 15.4-15.6, 15.7-15.75, 15.8-16.0, 16.0-16.55, 17.55-18.05, 19.2-19.3, 19.9-20.55, 20.6-20.7, 20.75-26.0, 26.4-26.95, 27.4-27.45, 27.9-27.95, 28.05-30.6, 31.3-31.75, 31.8-32.5	X	-	-	-	Sheppard-Mayqueen portion is highly susceptible to wind erosion.	A,B,D

Table 10. SUMMARY OF POTENTIAL SOILS RECLAMATION PROBLEM AREAS[1] (continued)

Project Component	Map Unit or Soil Association[2]	Approximate Milepost or Acreage	Indicators of Potential Reclamation Problems				Comments	Potential Mitigation Measures for Consideration[7]
			High Wind Erosion Susceptibility[3]	High Water Erosion Susceptibility[4]	Area Reclaim[5]	Steep Terrain[6]		
Water Supply System (continued)								
P2[9]	Ma	9.95-10.1	X	-	-	-	Mayqueen is highly susceptible to wind erosion.	A,B,D
	SB	13.8-14.0	X	-	-	-	Sheppard portion is highly susceptible to wind erosion.	A,B,D
	HU	18.7-18.9, 19.0-19.2, 19.3-19.7	-	-	-	X	Muff portion - area reclaim.	A,B,C,D
	SC	30.9-31.3, 32.5-33.1, 36.2-37.9, 38.3-38.85, 41.3-42.1, 42.45-42.6	X	-	-	-	Sheppard portion is highly susceptible to wind erosion; Notal portion is highly susceptible to shrink-swell.	A,B,C,D
	DZ	31.75-31.8	X	-	-	-	Duneland is highly susceptible to wind erosion.	A,B,D
	Riverwash-Duneland	38.85-38.95	X	X	-	-	Duneland portion is highly susceptible to wind erosion; Riverwash portion is highly susceptible to water erosion.	A,B,C,D
	Turley-Fruitland-Blancot	38.95-39.5, 40.1-40.65, 40.85-41.2	X	-	-	-	Fruitland portion may be highly susceptible to wind erosion.	A,B,D
	Shiprock-Sheppard-Huerfano	41.2-41.3	X	-	-	-	Shiprock-Sheppard portion is highly susceptible to wind erosion.	A,B,D
		Totals[8]	28.4 miles	2.6 miles	3.2 miles	2.0 miles		
P3	HA	0.25-0.3	-	X	X	-	Haplargids-Torriorthents portion may be highly susceptible to water erosion; Blackston portion - area reclaim.	A,B,C,D
	Ay	0.3-0.75	-	X	-	-	This phase of the Avalon series is highly susceptible to water erosion.	A,B,C,D

Table 10. SUMMARY OF POTENTIAL SOILS RECLAMATION PROBLEM AREAS[1] (continued)

Project Component	Map Unit or Soil Association[2]	Approximate Milepost or Acreage	Indicators of Potential Reclamation Problems				Comments	Potential Mitigation Measures for Consideration[7]
			High Wind Erosion Susceptibility[3]	High Water Erosion Susceptibility[4]	Area Reclaim[5]	Steep Terrain[6]		
Water Supply System (continued)								
P3	FX	0.75-1.55, 1.7-2.85, 7.0-9.25, 24.9-25.45, 25.7-26.05, 28.15-28.25, 28.28-28.4, 28.6-28.7, 29.45-29.75, 31.55-32.4, 32.65-33.0, 35.95-36.15	X	-	X	-	Sheppard portion is highly susceptible to wind erosion; Persayo portion - area reclaim.	A,B,C,D
	Sh	1.55-1.7	X	-	-	-	This phase of the Shiprock series is highly susceptible to wind erosion.	A,B,D
	DN	2.85-3.55	-	X	-	-	Avalon portion is highly susceptible to water erosion.	A,B,C,D
	DS	3.55-7.0, 12.05-12.8, 13.15-13.7, 16.0-20.9, 21.15-23.75, 23.8-24.9, 25.45-25.7, 26.45-28.15, 28.7-29.45, 29.75-31.55, 33.3-34.4, 34.65-35.95, 36.45-37.5	X	-	-	-	Sheppard portion is highly susceptible to wind erosion.	A,B,C,D
	FA	10.6-10.85	-	-	X	-	Persayo portion - area reclaim, shallow soils.	A,B,C,D
	RA	11.3-11.4	-	X	-	-	Riverwash is highly susceptible to water erosion.	A
	BA	13.7-16.0	-	X	-	X	Badland areas (>15% slope) are highly susceptible to water erosion in trenched areas. This area includes slopes of about 35% (i.e., would require intensive stabilization measures).	C
	SC	37.5-38.3, 42.35-43.9, 44.7-45.1, 45.85-48.5	X	-	-	-	Sheppard portion is highly susceptible to wind erosion; Notal portion is highly susceptible to shrink-swell.	A,B,C,D
		Totals[8]	33.97 miles	3.6 miles	7.42 miles	2.3 miles		

Table 10. SUMMARY OF POTENTIAL SOILS RECLAMATION PROBLEM AREAS[1] (continued)

Project Component	Map Unit or Soil Association[2]	Approximate Milepost or Acreage	Indicators of Potential Reclamation Problems: High Wind Erosion Susceptibility[3]	High Water Erosion Susceptibility[4]	Area Reclaim[5]	Steep Terrain[6]	Comments	Potential Mitigation Measures for Consideration[7]
Water Supply System (continued)								
Proposed Terminal Storage Reservoir	SC	35	X	-	X	-	Sheppard portion is highly susceptible to wind erosion; Muff portion - area reclaim, Notal portion is highly susceptible to shrink-swell.	A,B,C,D
		Totals[8]	35 acres	0	35 acres	0		
Terminal Storage Reservoir Alternative	HU	71	-	-	X	-	Muff portion - area reclaim.	A,B,C,D
	DN	4	-	X	-	-	Avalon portion is highly susceptible to water erosion.	A,B,C,D
		Totals[8]	0	4 acres	71 acres	0		
Transmission Line Corridors								
T5	Sheppard-Huerfano-Notal/ Badland-Rock Outcrop-Monierco	0.0-5.0	X	-	-	-	Sheppard portion is highly susceptible to wind erosion; Notal portion is highly susceptible to shrink-swell.	A,B,C,D
		Totals[8]	5 miles	0	0	0		
T2	Sheppard-Huerfano-Notal	0.75-17.25, 21.0-32.0	X	-	-	-	Sheppard portion is highly susceptible to wind erosion; Notal portion is highly susceptible to shrink-swell.	A,B,C,D
	Penistaja-Valent	35.0-38.5	X	-	-	-	Moderate to high wind erosion hazard.	A,B,D
	Penistaja-Valent/ Hageman-Travessilla	38.5-40.0	X	-	-	-	Moderate to high wind erosion hazard.	A,B,D
	Hageman-Travessilla	45.5-46.25, 46.5-49.5	X	-	-	-	Moderate to high wind erosion hazard.	A,B,D
	Las Lucas-Litle-Persayo	49.5-52.0, 53.0-57.5, 83.75-99.5	-	X	-	-	Las Lucas portion is highly susceptible to water erosion.	A,B,C,D
	Hageman-Travessilla/ Las Lucas-Litle-Persayo	52.0-53.0	X	X	-	-	Low to high wind erosion hazard; Las Lucas portion is highly susceptible to water erosion.	A,B,C,D

Table 10. SUMMARY OF POTENTIAL SOILS RECLAMATION PROBLEM AREAS[1] (continued)

Project Component	Map Unit or Soil Association[2]	Approximate Milepost or Acreage	Indicators of Potential Reclamation Problems				Comments	Potential Mitigation Measures for Consideration[7]
			High Wind Erosion Susceptibility[3]	High Water Erosion Susceptibility[4]	Area Reclaim[5]	Steep Terrain[6]		
Transmission Line Corridors (continued)								
T2	Litle-Las Lucas	57.5-63.5, 74.75-75.5	-	X	-	-	Las Lucas portion is highly susceptible to water erosion.	A,B,C,D
	Christianburg-Navajo/ Litle-Las Lucas	75.5-76.25	-	X	-	-	Navajo and Las Lucas are highly susceptible to water erosion.	A,B,C,D
	Christianburg-Navajo	76.25-77.0	-	X	-	-	Navajo portion is highly susceptible to water erosion.	A,B,C,D
		Totals[8]	37.3 miles	32.0 miles	Unknown	0		
T1	Sheppard-Huerfano-Notal	0.5-11.5, 15.5-18.5	X	-	-	-	Sheppard portion is highly susceptible to wind erosion; Notal portion is highly susceptible to shrink-swell.	A,B,C,D
	Shiprock-Sheppard-Doak	11.5-15.5, 30.0-31.5	X	-	-	-	Sheppard portion is highly susceptible to wind erosion.	A,B,D
	Sheppard-Huerfano-Notal/ Persayo-Fruitland-Sheppard	18.5-19.5	X	-	-	-	Sheppard portion is highly susceptible to wind erosion.	A,B,C,D
	Persayo-Fruitland-Sheppard	19.5-21.0, 22.25-22.75, 23.5-25.5, 26.75-29.5	X	_	_	_	Sheppard portion is highly susceptible to wind erosion.	A,B,C,D
	Shiprock-Sheppard-Doak/ Persayo-Fruitland-Sheppard	25.5-26.75, 29.5-30.0	X	-	-	-	Sheppard portion is highly susceptible to wind erosion.	A,B,C,D
	Penistaja-Valent-Rockland	34.5-41.0, 45.5-50.75	X	-	-	-	Moderate to high wind erosion hazard.	A,B,D
	Penistaja-Valent	50.75-56.5	X	-	-	-	Moderate to high wind erosion hazard.	A,B,D
	Penistaja-Berent-Sandstone Outcrop	57.25-64.75	X	-	-	-	Moderate to high wind erosion hazard.	A,B,D
	Litle-Las Lucas	64.75-69.75, 79.75-80.5	-	X	-	-	Las Lucas portion is highly susceptible to water erosion.	A,B,C,D
	Christianburg-Navajo	80.5-81.0	-	X	-	-	Navajo portion is highly susceptible to water erosion.	A,B,C,D

Table 10. SUMMARY OF POTENTIAL SOILS RECLAMATION PROBLEM AREAS[1] (continued)

Project Component	Map Unit or Soil Association[2]	Approximate Milepost or Acreage	Indicators of Potential Reclamation Problems: High Wind Erosion Susceptibility[3]	High Water Erosion Susceptibility[4]	Area Reclaim[5]	Steep Terrain[6]	Comments	Potential Mitigation Measures for Consideration[7]
Transmission Line Corridors (continued)								
T1	Las Lucas-Litle-Persayo	81.0-82.5, 85.0-92.0, 94.0-102.75	-	X	-	-	Las Lucas portion is highly susceptible to water erosion.	A,B,C,D
	Madurez-Caliza-Wink	102.75-108.0	X	-	-	-	Moderate to high wind erosion hazard.	A,B,D
		Totals[8]	56.6 miles	23.5 miles	Unknown	0		
T3	Sheppard-Huerfano-Notal	0.75-1.25, 3.5-5.5, 6.0-17.25	X	-	-	-	Sheppard portion is highly susceptible to water erosion; Notal portion is highly susceptible to shrink-swell.	A,B,C,D
	Sheppard-Huerfano-Notal/ Shiprock-Sheppard-Doak	1.25-3.5	X	-	-	-	Sheppard portion is highly susceptible to water erosion.	A,B,C,D
	Persayo-Billings	17.25-19.0, 24.0-25.75, 27.25-28.0, 32.0-32.5	-	X	-	-	Billings portion is highly susceptible to water erosion.	A,B,C,D
	Hagerman-Travessilla	30.0-32.0, 32.5-61.5	X	-	-	-	Moderate to high wind erosion hazard.	A,B,D
	Litle-Las Lucas	79.75-80.5	-	X	-	-	Las Lucas portion is highly susceptible to water erosion.	A,B,C,D
	Christianburg-Navajo/ Litle-Las Lucas	80.5-81.25	-	X	-	-	Navajo and Las Lucas are highly susceptible to water erosion.	A,B,C,D
	Christianburg-Navajo	81.25-82.0	-	X	-	-	Navajo portion is highly susceptible to water erosion.	A,B,C,D
	Las Lucas-Litle-Persayo	88.75-104.5	-	X	-	-	Las Lucas portion is highly susceptible to water erosion.	A,B,C,D
		Totals[8]	47.0 miles	22.75 miles	Unknown	0		
T4	Sheppard-Huerfano-Notal	0.0-4.5, 6.25-8.0, 14.5-20.25	X	-	-	-	Sheppard portion is highly susceptible to wind erosion; Notal portion is highly susceptible to shrink-swell.	A,B,C,D
	Shiprock-Sheppard-Doak	5.25-6.0	X	-	-	-	Sheppard portion is highly susceptible to wind erosion.	A,B,D

Table 10. SUMMARY OF POTENTIAL SOILS RECLAMATION PROBLEM AREAS[1] (concluded)

Project Component	Map Unit or Soil Association[2]	Approximate Milepost or Acreage	Indicators of Potential Reclamation Problems: High Wind Erosion Susceptibility[3]	High Water Erosion Susceptibility[4]	Area Reclaim[5]	Steep Terrain[6]	Comments	Potential Mitigation Measures for Consideration[7]
Transmission Line Corridors (continued)								
T4	Rock Land-Billings/ Chipeta-Sheppard-Shiprock	20.25-25.0	X	X	-	-	Sheppard portion is highly susceptible to wind erosion; Billings and Chipeta are highly susceptible to water erosion.	A,B,C,D
	Rock Land-Billings	25.0-27.5	-	X	-	-	Billings portion is highly susceptible to water erosion.	A,B,C,D
	Hagerman-Travessilla	27.5-33.5, 34.0-60.0, 72.0-72.5	X	-	-	-	Moderate to high wind erosion hazard.	A,B,D
	Las Lucas-Litle-Persayo	68.5-68.75, 75.5-76.0, 79.5-80.5, 102.25-103.75, 104.0-105.5, 120.25-122.25	-	X	-	-	Las Lucas portion is highly susceptible to water erosion.	A,B,C,D
	Rock Land-Thunderbird	76.0-77.5, 78.0-81.0, 94.25-96.0, 98.25-100.75	-	-	-	X	Sloping areas (>15% slope) may be highly susceptible to water erosion where graded and/or bladed. Thunderbird portion - moderate to high shrink-swell potential.	A,B,C,D
	Christianburg-Navajo	108.5-115.0, 117.25-118.25, 118.5-120.25	-	X	-	-	Navajo portion is highly susceptible to water erosion.	A,B,C,D
		Totals[8]	50.0 miles	23.25 miles	Unknown	8.75 miles		

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[1] Typically more than one soil series or association is present for a specific area along the linear project components. Since it is not known what specific soil series would be traversed in many areas, a conservative approach was used in compiling this table. Undesirable soil characteristics are listed for whole soil associations, but the problem soil usually constitutes only a fraction of the whole association. It is very probable that many of the potential reclamation problems listed would not be encountered, because the problem soils would not be traversed. Additionally, problems could be encountered in some areas not listed in this table (i.e., available soils data are not necessarily adequate to predict all potential reclamation problem areas).

[2] Sources: Refer to Tables 1 through 9 in this technical report.

[3] Based on WEG classes where: Classes 5-8 = low, 3-4L = moderate, and 1-2 = high.

[4] Based on K factor values where: <.2 = low, .2-.39 = moderate, and ≥.4 = high.

[5] Areas that are difficult to reclaim if soil is removed for construction or other purposes. Source: applicable SCS Form 5 - Soil Interpretation Tables. Most of the soils data that are available for the transmission line corridors are too general for use in identifying area reclaim locations; thus potential area reclaim problems were not identified. Topsoiling should be considered as a potential mitigation measure for graded/bladed areas along transmission line ROWs.

[6] Source: USGS topographic maps (1:24,000; 1:62,500; and 1:250,000 scales). Criteria: >15% slope.

[7] A = Mulch denuded areas or consider covering with jute fabric (primarily on dune areas) or riprap (drainages). B = Topsoiling. C = Water diversions (e.g., water bars). D = Reseeding.

[8] Areas with multiple problems are listed and counted under each applicable potential problem (i.e., some areas counted more than once).

[9] Mileposts 5.5-13.0 and 15.5-18.0 of alternative main water pipeline P2 are developed portions of Block 4 - Navajo Indian Irrigation Project (NIIP). The listed indicators of potential reclamation problems may not apply to these areas, because intensive corrective measures have been applied to these areas (e.g., addition of fertilizer, gypsum, sulphur, etc.). If alternative main water pipeline P2 is ultimately selected, special care should be taken in these areas (especially topsoiling) in order to maintain their productivity.

the disturbed rights-of-way (ROW) should recover within three to five years (i.e., the native grass cover would be reestablished). The soils data in the Affected Environment section (including Table 2) of this background report indicate that some areas would be difficult to reclaim due to adverse physical and chemical soil properties such as: undesirable surface textures, poor topsoil, high wind erosion susceptibility, excess salts, and alkalinity. In addition, the low precipitation in this area could inhibit the success of reclamation efforts. In some areas it may be necessary to reseed several times, and special erosion control practices might be needed to stabilize soils (e.g., in sandy or dune-type areas) prior to successful revegetation. Water bars and possible other water diversion techniques would be used on sloping areas to reduce water erosion and help maintain soil stability. Selection of seed species specifically adapted to local soils (and climates), as well as timing and methods of reseeding, are essential prerequisites for successful revegetation on problem soil areas.

Excess salts and alkalinity problems could increase in some areas if trenched materials, which in some cases (e.g., shale) are more toxic than the overlying topsoils, were mixed with the topsoil or placed on the surface.

The sandy soils that occur intermittently from MP 2.0 to the end of the proposed main water pipeline route (P1) are of special concern due to their high susceptibility to wind-induced soil erosion. Intensive mitigation measures may be required to stabilize the ROW in these areas and successful revegetation may be difficult to accomplish. Special construction methods in dune areas should include burying the pipeline deeply and minimizing vegetation disturbance.

Badland (nonstony, barren shale) areas are traversed by this proposed water pipeline route (refer to Table 2), and these areas are virtually impossible to vegetate. In sloping Badland areas, water bars should be used to keep water from moving down and eroding materials out of the trench. Shrink-swell problems may be encountered in these Badland areas.

The Proposed Action calls for a second main water pipeline to be layed within the same ROW as the first pipeline, approximately five years after the first pipeline is laid. This would cause the same ROW to be disturbed again, just about the time it had recovered from the first disturbance. Conversations with local BLM personnel (Spears 1982) indicate that the ROW should be able to recover again, as long as it is reseeded again. Revegetation success would probably be lower after the second disturbance.

Mileposts for potential soils reclamation problem areas along this pipeline route are listed in Table 10 by map unit or soil association and the specific indicators of potential reclamation problems. Table 10 also lists potential mitigation measures which would increase reclamation success in these areas.

The proposed main water pipeline P1 (including intermediate pump stations 2 and 3) traverses Blocks 6, 7, 9, 11, and 10 of NIIP, all of which are currently undeveloped. Congress has cut off funding for NIIP, thus it is not known if (or when) the aforementioned undeveloped blocks will be developed. Mileposts of the areas determined to be irrigable within these undeveloped NIIP blocks are listed in the Affected Environment section. If proposed main water pipeline P1 were ultimately selected and these NIIP blocks were developed prior to construction of P1, special construction and reclamation measures should be used in these areas. Special measures for maintaining productivity should include laying both pipes (initial and second pipeline) simultaneously and topsoiling. Assuming P1 was ultimately the NIIP project should be reevaluated prior to construction. If NIIP funding had been restored and the aforementioned NIIP blocks were to be eventually developed, special construction and reclamation measures should be taken. Special construction and reclamation measures for these areas should include laying both pipes simultaneously, topsoiling, and reseeding, so that the potential productivity of these areas is not significantly reduced.

A monitoring program would be conducted over the life of the pipeline and would include visual identification of problem soil erosion areas and other areas not responding adequately to the revegetation program. Once identified, problem soil areas would undergo more intensive reclamation and mitigation in order to help ensure soil stability, structural integrity of the pipeline, renewed forage/crop production, and an aesthetically acceptable condition. The monitoring program would be conducted by BLM personnel or a reclamation specialist approved by the BLM. Identification of problem areas would also be conducted by the applicant during routine aerial patrols.

Indirect impacts to the soils resource could occur if construction of the pipeline ROW allows some previously inaccessible areas to be accessible to ORVs. The degree and areal extent of such disturbances are unknown, but would probably be limited to about 5 miles on either side of the ROW. Since this pipeline route generally follows State Highway 371, it would not provide very much new access to ORVs. General impacts to the soils resource which would result from increased ORV use are: soil compaction, reduced infiltration capacity, reduced vegetative cover, and increased erosion susceptibility. An effort should be made to limit ORV access along the pipeline ROW to reduce potential impacts to the ROW as well as surrounding areas.

Main Water Pipeline Alternative P2. Construction of main water pipeline alternative P2 (including intake pumping plant and intermediate pump stations) would directly disturb approximately 508 acres of soils and topography. Construction of staging and work areas at pump station sites and stream, road, and canal crossings would cause a small amount of additional disturbance.

The soils data presented in the Affected Environment section (including Table 3) of this background report indicate that the same impacts and reclamation problems discussed for the proposed main water pipeline route (P1) would be encountered along this route. Some of the sandy soils that occur intermittently over the entire length of this route are also highly susceptible to wind-induced soil erosion. This alternative route also traverses Badland areas (refer to Table 3).

Mileposts for potential soils reclamation problem areas (and associated mitigation measures for consideration) along this alternative water pipeline route are presented in Table 10.

Main water pipeline alternative P2 traverses developed portions of NIIP-Block 4 (MP 5.5-13 and 15.5-18). Intensive corrective measures (addition of fertilizer, gypsum, sulphur, etc.) have been applied to these areas in order to increase their productivity. If this alternative pipeline was ultimately selected, special construction and reclamation measures should be used in these areas. Special measures for maintaining productivity in these areas should include laying both pipes simultaneously and topsoiling. This alternative pipeline route also traverses undeveloped portions of NIIP-Block 11. These undeveloped portions (refer to Affected Environment section for applicable pipeline mileposts) have been determined to be irrigable. Congress has cut off funding for NIIP, and it is not known if (or when) Block 11 will ever be developed. Refer to the proposed main water pipeline (P1) for a discussion of special construction and reclamation measures which could apply to P2 under two different potential NIIP development scenarios.

If this alternative main water pipeline route were ultimately selected, a second pipeline would be laid within the same ROW within five years after the initial pipeline was layed. The monitoring program discussed for the proposed main water pipeline (P1) applies to this alternative route as well.

Potential indirect impacts to the soils resource from increased ORV access are the same as discussed for proposed main water pipeline (P1).

Main Water Pipeline Alternative P3. Construction of main water pipeline alternative P3 (including intake pumping plant and intermediate pump stations) would disturb approximately 574 acres of soils and topography. A small amount of additional disturbance would occur during construction of staging and work areas at pump station sites and stream and road crossings.

The soils data presented in the Affected Environment section (including Table 4) of this background report indicate that the same impacts and reclamation problems discussed for the proposed main water pipeline route (P1) would be encountered along this route. Many of the sandy soils that recur over the entire length of this alternative pipeline route are highly susceptible to wind-induced soil erosion. This alternative route traverses approximately the same amount of Badland areas as the proposed route (P1) and (P2) alternative route, but the areas of steeper terrain near the southern end of the Kutz Canyon (approximately 35 percent slope) would require more intensive mitigation to stabilize.

Mileposts for potential soils reclamation problem areas (and associated mitigation measures for consideration) along this alternative water pipeline route are presented in Table 10.

If this alternative main water pipeline were ultimately selected, a second pipeline would be layed within the same ROW with five years after the initial pipeline was layed. The monitoring program discussed for the proposed main water pipeline (P1) applies to this alternative route as well.

Potential indirect impacts to the soils resource from increased ORV access are the same as discussed for proposed main water pipeline (P1).

Proposed Terminal Storage Reservoir (R1). Construction and operation of the proposed terminal storage reservoir would take approximately 145 acres of soils out of production for the life of the project. Approximately 1.5 million cubic yards of material would be needed to construct an embankment (or dike) around 70 percent of the reservoir perimeter. Materials for construction of the embankment would be obtained from the reservoir area to the maximum practical extent, but the available soils data indicate that a significant volume of materials would have to be obtained from borrow areas outside the reservoir area. Over 50 percent of the proposed reservoir site is Badland (nonstony, barren shale), which can provide little if any materials suitable for embankment construction. The applicant's proposed erosion control and reclamation procedures for the reservoir and potential borrow areas are presented in Chapter 1 of the DEIS.

Acreages of potential soils reclamation problem areas (and associated mitigation measures for consideration) at this proposed reservoir site are presented in Table 10. The applicant's Proposed Action includes these measures.

Terminal Storage Reservoir Alternative (R2). Construction and operation of the terminal storage reservoir alternative would take approximately 75 acres of soils out of production for the life of the project. Although the alternate reservoir site does not contain any Badland, the available soils data indicate that a large volume of borrow materials would be needed to construct an embankment for this reservoir as well. Additionally, the Muff soil (95 percent of site) is difficult to reclaim.

Acreages of potential sites reclamation problem areas (and associated mitigation measures for consideration) at this alternative reservoir site are presented in Table 10. The applicant's Proposed Action includes these measures.

Transmission Lines

Proposed FC-A-P 500-kV Transmission Line Loop (T5). Construction of the proposed FC-A-P loop would directly disturb a maximum of 194 acres (not including portions within the boundary of NMGS) of soils and topography. Soil surface disturbance, excavation (tower sites), and grading, blading, trampling, and removal of vegetative cover would increase present soil erosion rates and soil instability. These increases would continue until denuded areas were revegetated. Grading and clearing of vegetation would be performed only where necessary for equipment access or safety considerations. The major disturbance to the soils resource associated with construction of the transmission lines would result from the blading required for construction of the temporary construction access roads (14 feet wide) along the ROW. Access roads would be closed to public travel and restoration measures would be applied after construction was completed. All graded or bladed areas would be reseeded, and erosion control measures would be applied where necessary. Most of the construction ROW would not be cleared of vegetation, graded, or bladed; thus impacts to the soils resource would generally be minor and short-term. The soils data presented in the Affected Environment section (including MP 0.0-5.0 of Table 9) of this background report indicate that some bladed/graded areas would be difficult to reclaim. The types of reclamation problems that would be encountered on graded/bladed areas are generally the same as those discussed for the proposed main water pipeline (P1).

Mileposts for potential soils reclamation problem areas along this proposed transmission line are presented in Table 10. Table 10 also lists potential mitigation measures which, if implemented, would increase reclamation success. The applicant's Proposed Action includes many of these measures. Assuming that the measures would be moderately successful, most of these areas would recover within 3-5 years. Reclamation success on deeply graded/bladed areas could be enhanced by stockpiling topsoil on the side of construction access roads and replacing it during the restoration phase. The monitoring program discussed for the proposed main water pipeline (P1) should also apply to this transmission line.

Potential indirect impacts to the soils resource from increased ORV access are the same as discussed for the proposed main water pipeline (P1). The applicant's Proposed Action states that transmission line access roads would be closed to public travel. If access roads were effectively closed, indirect impacts from ORVs would not occur.

First Proposed Transmission Corridor (T2). Construction of the first proposed transmission line would directly disturb a maximum of 2594 acres (including construction access roads, Rio Puerco Station, and other associated facilities) of soils and topography. As with the proposed FC-A-P loop, soil surface disturbance, excavation (tower sites), and grading, blading, trampling, and removal of vegetative cover would increase present soil erosion rates and soil instability. These increases would continue until denuded areas were revegetated. Blading required for construction of temporary access roads would constitute the major soils disturbance associated with construction of this transmission line. Clearing of vegetation, grading, and blading would be performed on a relatively small portion of the ROW, thus impacts to the soils resource would generally be minor and short-term. Table 6 of this background report indicates that some bladed/graded areas would be difficult to reclaim. Potential reclamation problems (refer to Table 10), the applicant's proposed corrective measures, and anticipated recovery period are generally the same as discussed (or alluded to) for the proposed FC-A-P loop (T5). The monitoring program discussed for the proposed main water pipeline (P1) should also apply to this transmission line.

Potential indirect impacts to the soils resource from increased ORV access are the same are discussed for the proposed transmission line loop (T5).

Second Proposed Transmission Corridor (T1). A maximum of 2595 acres (including construction access roads, Rio Puerco Station, and other associated facilities) of soils and topography would be directly disturbed during construction of this alternative. Expected types and causes of direct and indirect soils impacts, potential reclamation problems (refer to Table 10) the applicant's proposed corrective measures, and anticipated recovery period are generally the same as discussed (or alluded to) for the proposed FC-A-P loop (T5). The monitoring program discussed for the proposed main water pipeline (P1) should also apply to this transmission line.

Transmission Corridor Alternative T3. Construction of the transmission line alternative T3 would directly disturb a maximum of 2545 acres (including construction access roads, Rio Puerco Station, and other associated facilities) of soils and topography. Refer to the proposed FC-A-P loop (T5) discussion for expected types and causes of direct and indirect soils impacts, potential reclamation problems (refer to Table 10) the applicant's proposed corrective measures, and anticipated recovery period. The monitoring program discussed for the proposed main water pipeline (P1) should also apply to this transmission line alternative.

Transmission Corridor Alternative T4. A maximum of 3054 acres (including construction access roads, Rio Puerco Station, and other associated facilities) of soils and topography would be disturbed during construction of this alternative transmission line. Expected types and causes of direct and indirect soils impacts, potential reclamation problems (refer to Table 10) the applicant's proposed corrective measures, and anticipated recovery period are generally the same as discussed for the proposed FC-A-P loop (T5). This transmission corridor traverses areas of steeper terrain than the other corridor alternatives. The primary areas of concern are in southeastern McKinley County (between Canon de Marquez and Canon de Pedro Padilla [MP 94-96]), and in northeastern Cibola County (La Mesa del Canon Seco area [MP 98-101]). Terrain restrictions in these areas might necessitate placing a new transmission line directly adjacent to the existing transmission line that runs through these areas. The soil associations (Rock Land-Thunderbird and Little-Clovis-Travessilla) in these steep areas are shallow to moderately deep (includes rock outcrops), and erosion susceptibility is low to moderate. If this alternative were ultimately selected, special care during construction and reclamation phases should be taken to protect the existing soils resource in the aforementioned steep areas. The monitoring program discussed for the proposed main water pipeline (P1) should also apply to this transmission line.

PRIME AND UNIQUE FARMLANDS

The surface facilities associated with the Proposed Action and alternatives would not be located on Prime or Unique Farmlands, thus no long-term crop production losses on Prime or Unique Farmlands would occur. The intake/pumping plant associated with the proposed main water pipeline (P1) would take approximately 35 acres of potential (not irrigated and not used as cropland) Prime Farmland out of production for the life of the project. Proposed main water pipeline (P1) intermediate pumping stations 2 and 3 would preclude development of 2 acres of potential Statewide/Locally Important Farmland in Block 9 of NIIP. These potential impacts are not considered significant.

5.0

SPECIFIC MITIGATION MEASURES GENERATED BY THE IMPACT ASSESSMENT

Table 10 lists specific mitigation measures for consideration, as generated by the impact assessment. Mitigation measures for consideration are listed by project component, map unit of soil association, and mileposts (linear project components) or acreages. The types of mitigation measures proposed for consideration are: (1) mulching denuded areas or covering with jute fabric or riprap; (2) topsoiling; (3) water diversions; and (4) reseeding. These measures are listed (as applicable) for potential soils reclamation problem areas, where potentially significant impacts to the soils resource may occur if erosion control and reclamation measures are not implemented. The determination of potential soils reclamation problem areas was based on the following factors: (1) soils with high wind or water erosion susceptibility; (2) soils which are known to be difficult to reclaim; and (3) areas of steep terrain.

The available soils data which were used are not necessarily adequate to accurately predict all potential reclamation problem areas. Additionally, some of the areas listed in Table 10 would probably not be difficult to reclaim (i.e., determination based on available soils data and conservative approach).

In summary, Table 10 and the other soils data in this technical report should be used as a reference guide. BLM reclamation specialists will make an on-the-ground determination of appropriate erosion control and reclamation measures to be stipulated, prior to issuance of the ROW grant. In addition, BLM reclamation specialists will formulate a soils monitoring program for sensitive soils area.

6.0

UNAVOIDABLE ADVERSE IMPACTS

Unavoidable adverse impacts to the soils resource resulting from construction of the Proposed Action or alternatives would include: (1) increases in soil erosion and soil instability on disturbed areas; and (2) decreases in short-term soil productivity. If a moderately intensive erosion control and reclamation program (including monitoring) were implemented following construction, increases in soil erosion and instability would generally be short-term impacts (e.g., 3-5 years).

7.0

RELATIONSHIPS BETWEEN THE SHORT-TERM USE OF THE AFFECTED ENVIRONMENT AND THE ENHANCEMENT OF LONG-TERM PRODUCTIVITY

Assuming the erosion control and reclamation measures implemented following construction on temporarily disturbed areas were moderately successful, impacts to the soils resource should not result in significant long-term productivity losses. Construction and operation of the surface facilities associated with the proposed project would result in long-term productivity losses at these locations.

8.0

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Short-term increases in soil erosion due to construction of the proposed project would not cause temporarily disturbed areas to be irreversibly converted to other uses, and the viability of these areas should not be significantly diminished. The BLM monitoring program that would be conducted over the life of the project would include identification of problem soil erosion areas. Once identified, problem soil erosion areas would undergo more intensive reclamation and mitigation, thereby helping to ensure that irreversible and irretrievable commitments of the soils resource would not occur. Surface facility sites would be reclaimed upon project termination; thus these areas would not be permanently or irreversibly committed to other uses.

9.0

COMPARISON OF ALTERNATIVES

A comparison of the mitigation/reclamation potential for the main water pipeline alternatives is contained in Table 11. This comparison provides the primary basis for ranking the main water pipeline alteratives in the following order of preference: P1--first; P2--second; and P3--third. Main water pipeline route P1 is also preferred over P2 because it would cause less disturbance (474 acres versus 508 acres during construction, including river intake and intermediate pump stations); P1 has better access for construction/maintenance (e.g., State Highway 371); and P1 would probably not impact any developed NIIP blocks. Main water pipeline route P3 is ranked last because it would cause the most disturbance during construction (547 acres); and it traverses the most miles of steep terrain, area reclaim soils, and soils which are highly susceptible to wind and water erosion.

Table 11 also provides the primary basis for ranking the terminal storage reservoir alternatives in the following order of preference: proposed-first; alternative--second. The alternative reservoir site would be more difficult to reclaim (95 percent area reclaim soils), and it is located on an upland drainage sideslope which is undesirable from an erosion/reclamation standpoint.

The information in Table 11 also provides the primary basis for ranking the transmission line corridor route alternatives in the

Table 11. COMPARISON OF RECLAMATION POTENTIAL FOR ALTERNATIVES

Criteria for Comparison	Main Water Pipeline Route Alternatives			Terminal Storage Reservoirs		Transmission Line Corridor Alternatives			
	P-1	P-2	P-3	Proposed	Alternate	T-1	T-2	T-3	T-4
High susceptibility to wind-induced soil erosion[a]	31.7 mi	28.4 mi	34 mi	35 ac.	--	56.6 mi	37.3 mi	47 mi	50 mi
High susceptibility to water-induced soil erosion[b]	1.6 mi	2.6 mi	3.6 mi	--	4 ac.	23.5 mi	32 mi	22.8 mi	23.3 mi
Steep terrain[c]	1.4 mi	2 mi	2.3 mi	--	--	--	--	--	8.8 mi
Area reclaim[d]	4.4 mi	3.2 mi	7.4 mi	35 ac.	71 ac.	--	--	--	--
Potential for mitigation and successful reclamation[e]	mod	mod	low-mod	mod	low	mod-high	mod-high	mod-high	low-mod

[a] Based on WEG classes where: Classes 5-8 = low; 3-4L = moderate; and 1-2 = high.

[b] Based on K factor values where: <.2 = low; .2-.39 = moderate; and $\geq$ .4 = high.

[c] Areas with terrain slope greater than 15 percent.

[d] Area reclaim is an indicator of areas which would be difficult to reclaim. Transmission line corridor soils data are too general to use for identifying these areas.

[e] Principle items considered in determination include relative topsoil suitability, terrain ruggedness, expected success of standard BLM erosion control measures, and potential for successful revegetation.

following order of preference: T3--first; T2/T1--second; and T4--third. Transmission line corridor alternative T3 would cause the least amount of disturbance during construction (2545 acres), while T2 and T1 would cause about the same amount (2594 and 2595 acres, respectively). Transmission corridor alternative T4 would cause the most disturbance during construction (3054 acres), and it would traverse about 9 miles of steep terrain (i.e., potential reclamation problems).

POSSIBLE NEW TOWN

1.0

AFFECTED ENVIRONMENT

SOILS

The possible new town site is within the San Juan River Valley Mesas and Plateaus portion of the Western Range and Irrigated Region (SCS 1978a). Annual precipitation at the site generally ranges from 6 to 10 inches. Two different soil associations were identified at the site. Table 1 lists and characterizes the identified soils. A map (1:250,000 scale) showing the soils identified at the possible new town site is available for review at the BLM New Mexico State Office in Santa Fe.

The soils identified at the possible new town site are shallow to deep, but are primarily deep. The surface textures of the soils identified at the site range from loamy fine sand to silty clay loam. These soils are well to somewhat excessively drained. The identified soils are forming in eolian, alluvial, and residual materials derived primarily from sandstone, shale, and siltstone. These soils are forming primarily on gently to strongly sloping mesas, plateaus, intermittent drainageways, terraces, and fans. Topsoil availability at the possible new town site is good, but the topsoil quality is primarily fair to poor. Susceptibility of these soils to wind-induced erosion is moderate to high, and susceptibility to water-induced soil erosion is low to moderate. The identified soils are mildly to strongly alkaline, and shrink-swell potential ranges from low to high.

Table 1. CHARACTERISTICS OF THE SOILS IDENTIFIED AT THE POSSIBLE NEW TOWN SITE

Soil Association and Description[1]	Approximate Acreage	Soil Series	Depth to Bedrock (inches)	Slope (%)	Depth to High Water Table (feet)	Soil Reaction (pH)	Salinity (mmhos/cm)	Hydrologic Group	WEG Class	'K'	'T'	Comments
Sheppard-Huerfano-Notal: Deep to shallow, well to somewhat excessively drained, loamy fine sand, sandy clay loam, and silty clay loam soils formed on level to steep mesas, plateaus, valley bottoms, and fans from eolian, alluvial, and residual materials derived from sandstone, shale, and siltstone.	1,640	Sheppard	60+	0-40	>6	7.4-8.4	<2	A	2	.15	5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to fair, 6-10 inch precipitation zone. Shrink-swell potential is low to high, mildly to strongly alkaline soils.
		Huerfano	10-20	0-3	>6	7.9-9.0	>4	D	4L	.32	1	
		Notal	60	0-2	>6	7.9-9.0	4-8	D	4L	.37	5	
Shiprock-Sheppard-Doak: Deep, well to somewhat excessively drained, fine sandy loam, loamy fine sand, and loam soils formed on level to moderately steep mesas, plateaus, and terraces from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	760	Shiprock	60	0-8	>6	7.4-9.0	<4	B	3	.24	5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is fair to good, 6-10 inch precipitation zone. Shrink-swell potential is low to moderate, mildly to strongly alkaline soils.
		Sheppard	60+	0-30	>6	7.4-8.4	<2	A	1	.15	5	
		Doak	60+	0-5	>6	7.4-9.0	<2-4	B	3	.37	5	
(Total Acreage)	(2,400)											

[1] Source: U.S. Soil Conservation Service (SCS). 1979. General soil map, San Juan County, New Mexico, eastern part. Soil survey of San Juan County, New Mexico, eastern part.

These soils are currently used primarily for livestock grazing and wildlife habitat.

PRIME AND UNIQUE FARMLANDS

Since the possible new town could potentially take agricultural land out of production permanently, the new town site was evaluated to determine whether it includes any Prime or Unique Farmland. The soil types (DS, BT, SC, and FX) present at the possible new town site do not qualify as Prime Farmland (SCS 1978b and 1980). Additionally, the site contains no Unique or Statewide/Locally Important Farmlands.

2.0

ENVIRONMENTAL CONSEQUENCES

SOILS

Construction of the possible new town would directly disturb approximately 2400 acres of soils and topography, significantly affecting the existing soils. The entire possible new town site would probably be permanently changed from its preconstruction use (grazing and wildlife habitat) to an urban development.

Construction of utilities (e.g., water, gas, electrical power) and roads necessary for the possible new town would disturb an unknown amount of soils and topography. Additionally, an unknown amount of land in the vicinity of the possible new town could be adversely impacted by recreational pursuits (e.g., ORV use) of new town residents.

PRIME FARMLAND

Construction of the possible new town would not impact any Prime, Unique, or Statewide/Locally Important Farmlands.

GLOSSARY

Alluvium--Materials such as sand, silt, or clay, deposited on land by streams.

Area reclaim--An area which is difficult to reclaim if soil is removed for construction or other purposes. Revegetation and erosion control are extremely difficult.

Calcareous soil--Soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Clay--As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Drainage class (natural)--Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly a result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

- Excessively drained--Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

- Somewhat excessively drained-- Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

- Well drained--Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well-drained soils are commonly medium textured. They are mainly free of mottling.

- Moderately well drained--Water is removed from the soil somewhat slowly during some periods. Moderately well-drained soils are wet for only a short time during the growing season, but periodically for long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

- Somewhat poorly drained--Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

- Poorly drained--Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

- Very poorly drained--Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Eolian soil material--Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Excess salts--Excess water-soluble salts in the soil that restrict the growth of most plants.

Farmlands:

Prime--Land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops, and is also available for these uses (e.g., not urban built-up land). Numerous specific SCS criteria must be met for a soil to qualify as potential Prime Farmland. For a soil to qualify as Prime Farmland (in the NMGS project area in New Mexico) it must meet the specific criteria and be irrigated.

Unique--Land other than Prime Farmland that is used for the production of specific high value food and fiber crops. It has the special combination of soil quality, location, growing season, and moisture supply needed to economically produce sustained high quality and/or high yields of a specific crop when treated and managed according to acceptable farming methods.

Statewide/Locally Important--All irrigated cropland in New Mexico is considered to be Statewide/Locally Important.

Hydrologic soil groups--Refers to soils grouped according to their runoff-producing characteristics. The primary consideration is the inherent capacity of soil denuded of vegetation to permit infiltration. The slope and the kind of plant cover are not considered. Soils are assigned to four groups (A through D). In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material.

Loam--Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Permeability--The quality that enables the soil to transmit water or air, measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	<0.06 inch/hour
Slow	0.06 to 0.20 inch/hour
Moderately slow	0.20 to 0.60 inch/hour
Moderate	0.6 to 2.0 inches/hour
Moderately rapid	2.0 to 6.0 inches/hour
Rapid	6.0 to 20.0 inches/hour
Very rapid	20.0 inches/hour

Reaction, soil--A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction. The degree of acidity or alkalinity is expressed as:

Extremely acidic	<pH 4.5
Very strongly acidic	pH 4.5 to 5.0
Strongly acidic	pH 5.1 to 5.5
Moderately acidic	pH 5.6 to 6.0
Slightly acidic	pH 6.1 to 6.5
Neutral	pH 6.6 to 7.3
Mildly alkaline	pH 7.4 to 7.8
Moderately alkaline	pH 7.9 to 8.4
Strongly alkaline	pH 8.5 to 9.0
Very strongly alkaline	≥pH 9.1

Residuum (residual soil material)--Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Saline soil--A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium. Salinity ratings are based on the electrical conductivity of a saturated extract, as expressed in millimhos per centimeter (mmhos/cm) at 25°C. The degree of salinity is expressed as:

None	<2.0 mmhos/cm
Low	2.0 to 4.0 mmhos/cm
Moderate	4.0 to 8.0 mmhos/cm
High	8.0 to 16.0 mmhos/cm
Very high	>16.0 mmhos/cm

Sand--As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone--Sedimentary rock containing dominantly sand-sized particles.

Shale--Sedimentary rock formed by the hardening of a clay deposit.

Shrink-swell potential--The potential of a given soil to shrink when dry and swell when wet. Shrink-swell is associated with clay soils. Shrinking and swelling can damage roads, dams, buildings, foundations, and other structures. It can also damage plant roots.

Silt--As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone--Sedimentary rock made up of dominantly silt-sized particles.

Slick spot--A small area of soil having a puddled, crusted, or smooth surface and an excess of exchangeable sodium. The soil is generally silty or clayey, is slippery when wet, and is low in productivity.

Slope--The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. In the Soils Background Report the following slope classifications are used:

Nearly level or level	0 to 2%
Gently sloping	2 to 5%
Moderately sloping	5 to 9%
Strongly sloping	9 to 15%
Moderately steep	15 to 30%
Steep	30 to 50%
Very steep	50 to 75%
Extremely steep	>75%

Soil loss tolerance ("T" factor)--The "T" value is the amount of soil (tons/acre) that can be lost in a year from a particular soil series, while the soil continues to support sustained long-term productivity.

Subsoil--Technically, the B horizon; roughly, the part of the solum below plow depth.

Topsoil--The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter, and technically it corresponds to the A horizon.

Water erosion susceptibility--Relative susceptibility of a given soil series to water-induced erosion. In this report, based on Soil Conservation Service K factors where: <0.2 = low; 0.2-0.39 = moderate; and $\geq$ 0.4 = high.

Wind erosion susceptibility--Relative susceptibility of a given soil series to wind-induced erosion. In this report, based on Soil Conservation Service WEG classes where: Classes 5-8 = low; 3-4L = moderate; and 1-2 = high.

REFERENCES

Buchanan, B. 1978. Soils field research, soils map. Prepared (under contract) for Public Service Company of New Mexico. Albuquerque, New Mexico.

Fjefeth, W. (U.S. Soil Conservation Service, Gallup, New Mexico) August 17, 1981. Personal communication with R. Ray, Woodward-Clyde Consultants.

Hacker, L. (U.S. Soil Conservation Service, Rio Rancho, New Mexico) August 17, 1981. Personal communication with R. Ray, Woodward-Clyde Consultants.

Spears, M. (Bureau of Land Management, Farmington, New Mexico) January 8, 1982. Personal communication with R. Ray, Woodward-Clyde Consultants.

U.S. Soil Conservation Service (SCS). 1967. General soil map, Cabezon area, Sandoval County, New Mexico. Soil Survey, Cabezon Area, New Mexico.

________. 1971. Soil associations and land classification for irrigation, Sandoval and Los Alamos counties. New Mexico State University, Agricultural Experiment Station, Research Report 188.

________. 1973. Soil associations and land classification for irrigation, San Juan County. New Mexico State University, Agricultural Experiment Station, Research Report 257.

________. 1974a. Soil associations and land classification for irrigation, McKinley County. New Mexico State University, Agricultural Experiment Station, Research Report 262.

________. 1974b. Soil associations and land classification for irrigation, Valencia County. New Mexico State University, Agricultural Experiment Station, Research Report 267.

________. 1978a. Land resource regions and major land resource areas of the United States. (Map.)

________. 1978b. Mapping units of prime farmland in San Juan County, New Mexico (irrigated). (List.)

________. 1979. General soil map, San Juan County, New Mexico, eastern part. Soil Survey of San Juan County, New Mexico, eastern part.

________. 1980. Soil survey of San Juan County, New Mexico, eastern part.

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